NOVEMBER 1954

# Power Engineering


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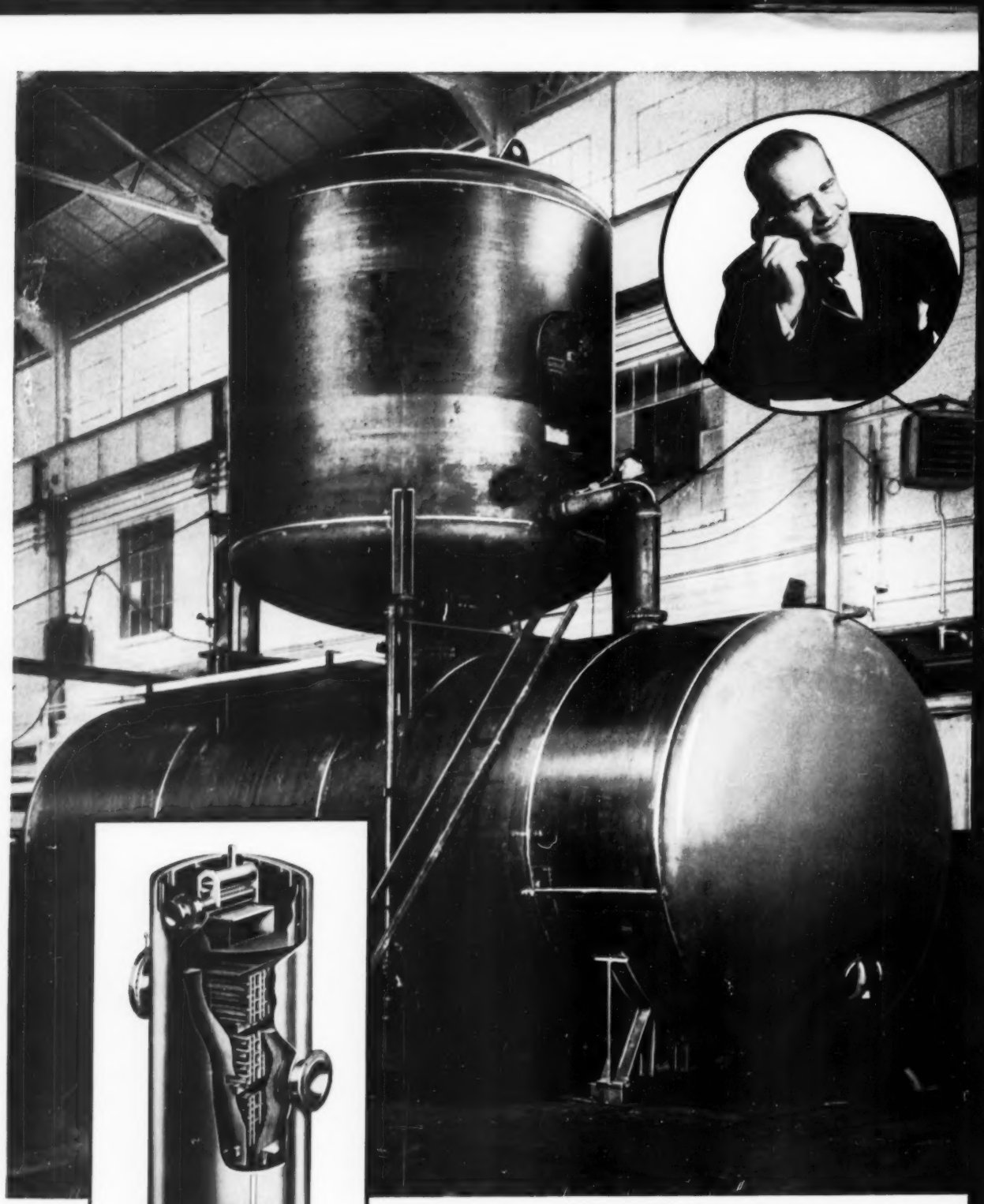

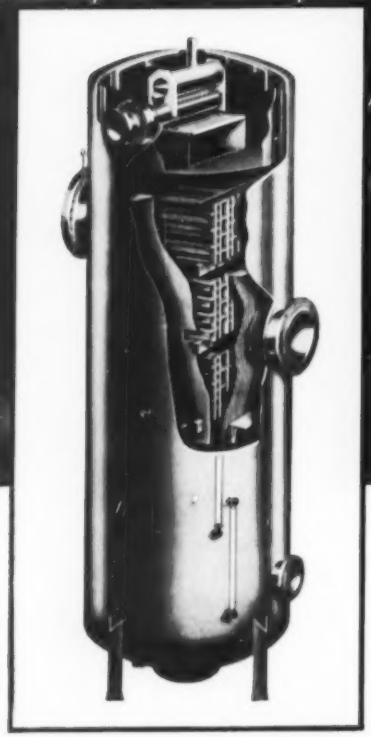

A 1,000,000-lb-per-hr deaerating feedwater heater mounted on its storage tank, just after passing its hydrostatic test in the Elliott shops. This is one of six similar units for an important utility.

◀ The latest design Elliott tray-type deaerating heater. This one is the multiple tray compartment type, designed to deliver water with commercial zero oxygen content.

# Back of **ELLIOTT** Deaerating Heaters

## ON-THE-SPOT FIELD SERVICE

In discussing deaeration problems with your Elliott sales engineer, you are getting the cooperation of an expert, factory-trained from the ground up in every aspect of deaeration, familiar with its principles as established step by step from Elliott's first pioneering unit of a generation ago, to the present space-saving, easily serviced design.

But that isn't all —

Spotted in strategically selected centers all over the country, are a corps of Elliott field service men, thoroughly capable in the diagnosing of operating difficulties and in their correction.

Beyond this, trained personnel in the home shops in Jeannette, Pennsylvania, stand ready when needed to travel to a trouble-spot as fast as the swiftest airplane can get them there.

So—when it's a deaeration problem, either a projected installation or the servicing of one already operating, pick up the phone and call your Elliott sales engineer. Or if more convenient write or wire Elliott Company, Deaerator and Heater Department, Jeannette, Pa.

**ATLANTA**
**BOSTON**
**BUFFALO**
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**ELLIOTT Company**

TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

For more data circle 501 on Post Card

# How to Figure the cost of STEAM TRAPS

**1. PRICE**—you get a lot of trap for your money when you buy an Armstrong: big capacity in small size; the long-lasting mechanism in traps for low and medium pressures is identical in design, workmanship and materials, to that in traps for 900 degrees, 950 lbs. pressure!

**2. INSTALLATION**—Armstrong gives you a choice of body styles to save installation labor and pipe fittings.

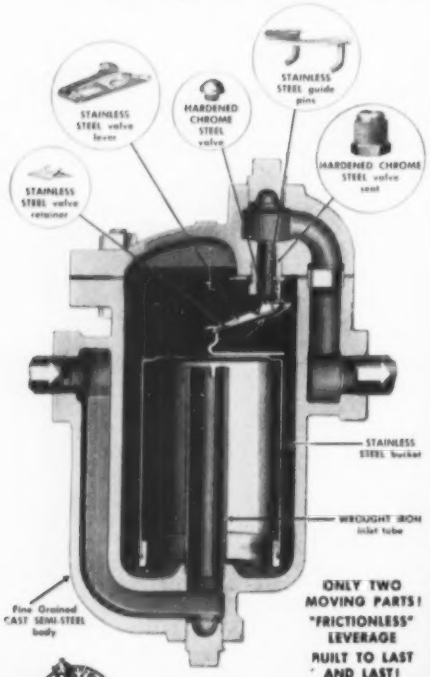
**3. MAINTENANCE**—Armstrong traps last longer! You save labor, parts cost and downtime. Freedom from leakage saves fuel.

Divide total trap cost by the life of the trap to get *costs per year*—this is where Armstrong traps really shine. Call your Armstrong Representative for the traps you need now, or write:

**ARMSTRONG MACHINE WORKS**
810 Maple Street • Three Rivers, Michigan

## *Full Facts In*
### *FREE Catalog J*

**Catalog J, also an educational handbook on condensate drainage, gives sizes, prices and capacities of Armstrong traps. It tells how to select traps; how to make hook-ups; how to trouble-shoot. Send for a copy today.**


STAINLESS STEEL valve lever
HARDENED CHROME STEEL valve
STAINLESS STEEL guide pins
HARDENED CHROME STEEL valve seat
STAINLESS STEEL valve retainer
STAINLESS STEEL bucket
WROUGHT IRON inlet tube
Fine Grained CAST SEMI-STEEL body
ONLY TWO MOVING PARTS!
"FRICTIONLESS" LEVERAGE
BUILT TO LAST AND LAST!

| STEAM TRAP CHECK LIST | ARMSTRONG TRAPS |
|---|---|
| Hardened chrome steel valve and seat? | Yes |
| All other parts stainless steel? | Yes |
| Long-lasting "frictionless" leverage? | Yes |
| Self-cleaning, non-clogging operation? | Yes |
| Choice of body styles? | Yes |
| Available with built-in strainers? | Yes |
| Available with internal check valves? | Yes |
| 40 years inverted bucket trap experience? | Yes |
| Guaranteed *unconditionally* to satisfy? | Yes |

# ARMSTRONG STEAM TRAPS COST LESS!

For more data circle 502 on Post Card

# ENGINEERS' PREVIEW

PUBLIC SERVICE Electric and Gas Co. has announced the start of construction of a new electric generating station in Linden, N. J. Located on a 120-acre tract adjacent to the Bayway Refinery of the Esso Standard Oil Co., the new station will provide additional power for the entire Public Service system and will also furnish the electrical and steam needs of the refinery, which will supply fuel for the station by pipe line.

First turbine generator, capable of producing 225,000 kw, is scheduled for operation early in 1957 and will be followed by a second machine of similar size in the fall of that year. Other units will be added as needed, the property being large enough for the addition of four more units.

Included in the design of the new equipment are such features as 26-in. turbine blades, the tips of which will travel at a speed faster than sound. Boilers and furnaces will be located outdoors. Water for the boilers will be purified in large demineralizers of latest design. Arrangement for fuel supply to be received by pipe line direct from the refinery will eliminate dock and pumping equipment.

• • •

**WORLD'S largest mobile electric generating plant, the 6000-ton, 34,500-kw YFP-10, began trial operation in July at the Gibbs Corp. shipyard, Jacksonville, Fla. It was converted by Gibbs for the Navy's Bureau of Yards and Docks from the dry cargo vessel *Coastal Racer*.**

**The YFP-10 can supply the electrical requirements of major naval installations, or of a city of 100,000 population. The plant could be used as a main power source, permanently moored, or to supplement the existing supply where industrial, naval or military demands overtaxed the normal facilities.**

• • •

SIXTY-FOUR complete scholarships valued at more than $15,000 will be awarded by the International Correspondence Schools to persons unable to attend college. While many of the subjects included in the ICS curriculum are at college level, only those persons who do not plan to attend college will be considered as candidates. Further information may be obtained from John C. Villaume, Dean of the Faculty. International Correspondence Schools, Scranton, Penna.

• • •

**INDUSTRIAL Gas Turbine Company has been formed to manufacture and sell gas turbines and auxiliary apparatus. According to Jacob Yavitch, president, the company is now engaged in producing a 75-hp gas turbine of its own design for testing and demonstration purposes.**

• • •

GENERAL ELECTRIC CO. has formed an Atomic Power Equipment Component, which will market atomic power equipment for commercial use. It will engineer, manufacture, and sell various types of low power reactors, and reactor systems, heat transfer and cooling system components, safety and remote-handling devices for radioactive material, and other related atomic reactor equipment.

• • •

**INTERPRETING Graphitization — a Report for Power Plant Engineers, by Herman Thielsch, metallurgical engineer, Industrial Piping Division, Grinnell Co., has just been issued as Report No. 1 of a series of interpretive reports to be issued by the company. It reviews the causes and occurrence of**

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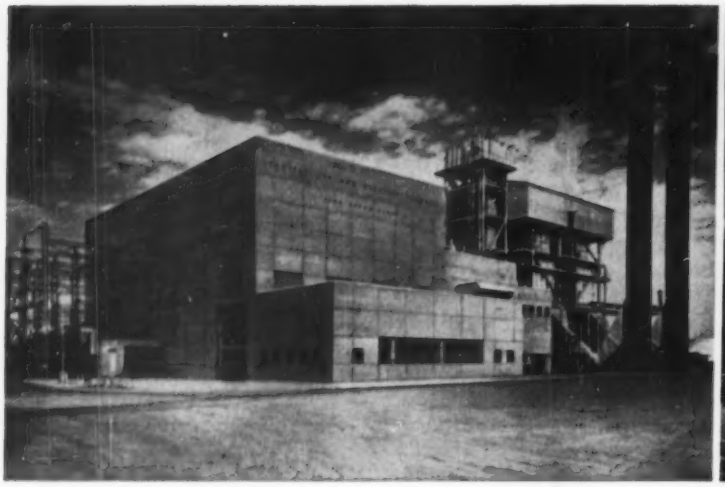
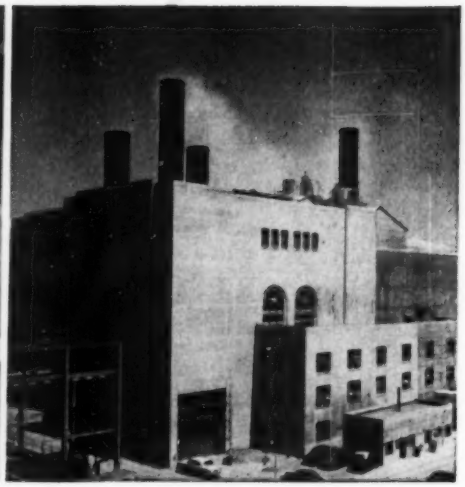
PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

# *Oh, I see*



KERN, 235,000 HORSEPOWER



STATION P, 360,000 HORSEPOWER

## . . . they're using OIC Valves at Pacific Gas & Electric Company

More power to northern and central California entails harnessing huge volumes of steam . . . directing flow of great streams of water. Both demand positive control by valves with the capacity to give long, trouble-free service.

That's why OIC Valves have gained acceptance at these two Pacific Gas & Electric Company stations . . . and at other generating plants in the country.

Write for the OIC *Catalog Digest, form 197* . . . and the new OIC *Valve Comparison Chart, form 194,* which compares valves of 15 manufacturers. Both are free.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

OIC FOUNDED 1883

VALVES | BRONZE & IRON, FORGED & CAST STEEL, LUBRICATED PLUG VALVES

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graphitization in steel used at high temperatures in power plant work, then discusses in some detail the various measures by which the steam power system can be restored to safer operation. The report is illustrated by specific examples of graphitization and sketches of various rehabilitation procedures. If you want a copy, write the Editor, *Engineers' Preview*.

• • •

**THE KETT CORPORATION,** Cincinnati consulting engineers, has appointed Glenn C. Boyer to be staff consultant on power plant engineering. A former associate professor of mechanical engineering at the Missouri School of Mines, he is author of the book Diesel and Gas Engine Power Plants and numerous technical articles. He is a member of the ASME Internal Combustion Engine Test Code Committee and a past chairman of the Oil and Gas Power Division of ASME.

• • •

ROBERT J. KRIEGER has been appointed vice-president-sales by Riley Stoker Corp. Mr. Krieger was associated with the Underfeed Stoker Corp. of America at Detroit before joining Riley Stoker Corp. in 1922 as manager of sales service department. In 1949 he was appointed sales manager, a position he occupied until his recent appointment.

• • •

**EIGHT-PAGE** reprint of a technical paper, now available from Hall Laboratories, Inc., contains observations made by its service engineers concerning the practical performance of various gadgets used to prevent scale and corrosion in industrial and commercial boilers, evaporators, heat exchangers, and water piping.

References are given describing a number of the various water-conditioning gadgets which have appeared on the market since 1865, claiming to treat water by nonchemical means to prevent scale and other troubles encountered in the industrial use of water.

Copies of the paper, entitled Practical Performance of Water-Conditioning Gadgets, are available without cost from Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Mighty arresting trouble signal on that control panel!

**NEW SYSTEM** of alloy designations for wrought aluminum and aluminum alloys has been developed by The Aluminum Association and recently went into operation. The new designations became effective on October 1, 1954. The temper designations in effect since 1947 are being continued without change and, as in the past, will follow the alloy designations.

Consisting of four-digit numbers, the new system is expected to meet all of the industry's present and future needs for wrought alloys. To aid in the transition from designations previously in use to the new system, many of the old numbers are retained as the last two digits of the new numbers. Thus, alloy 3S becomes 3003; 24S becomes 2024; and 61S becomes 6061.

• • •

WILLIAM B. WILSON has been appointed manager of the General Electric Co.'s industrial power generation unit. As manager, Mr. Wilson will co-ordinate G-E's application engineering activities in the field of power and steam generation for industrial users.

• • •

**HARVEY F. MCPHAIL,** whose retirement from the U. S. Bureau of Reclamation was announced recently, has been appointed head of the Hydroelectric Division of the Kuljian Corp., with headquarters in Philadelphia. He will supervise the engineering and construction of water-power projects not only in this country, but abroad. During his 35 years of service, Mr. McPhail supervised the design and construction of the generating systems of Grand Coulee, Hoover, and Shasta Dams. Last year he was awarded a Citation of Distinguished Service for his role in developing the vast power program of the U. S. Department of the Interior.

# LETTERS TO THE EDITORS

## Kingston Steam Plant

MY ATTENTION has just been called to a photograph and description of Kingston Steam Plant in the June issue of POWER ENGINEERING, page 75.

1 — The statement about the capacity, namely, "authorized capacity of the plant is 1,440,000 kw, but it will ultimately develop 1,600,000 kw." As a matter of fact, the ultimate capacity of 1,440,000 kw is already authorized and 1,600,000 kw is the capability of this plant. More and more we are dropping the word "capacity" and using "capability" as it seems to be more general practice to give the size of plants in terms of capability instead of capacity.

2 — Size of units as given is incorrect. The first four units are rated 150,000 kw capability, making a total of 600,000 and the last five units of 200,000 kw capability making 1,000,000 kw, so that the total of the nine units is 1,600,000 kw capability.

3 — Amount of coal, instead of 450 million tons is 4,300,000 tons per year, based on an 80 per cent load factor.

4 — The actual working pressure will be 1800 psi. *Henry Wiersema, Knoxville, Tenn.*

*Editor's Note:* — Mr. Wiersema is assistant to the chief engineer, Tennessee Valley Authority. He ought to know. Our source of information works closely with TVA and we assumed he ought to know, too. Sorry.

# HERE'S WHAT THEY TELL US

**Harvey Chaloupka,** Survey Engineer for Armour and Company, Union Stock Yards, Chicago, was one of many readers interested in the article on Practical Radioactivity — August issue, page 63. *Further information covering any division of this subject is available for the asking.*

Mr. Chaloupka's question was concerned with detecting underground leaks in water lines using Radioactive Iodine I. 131. He asked:

> What effect, if any, would there be should this radioactive iodine water come in contact with food, clothing, human beings and animals?

According to **Editor Andrew Kramer,** the use of radioactive iodine I. 131 as a tracer in the detection of underground leaks in water mains, involves no particular hazard for two reasons: First, the amounts of these tracer materials used are extremely minute; and second, the half life of radioactive iodine I. 131 is relatively short — 8 days. Thus, even if an appreciable amount of I. 131 was ingested, its effect in destroying living cells would diminish rapidly.

While these tracer techniques are widely applicable in the solution of many industrial problems, the greatest single deterrent to their wider use lies in the shortage of people trained in the special techniques necessary for handling and using these. To overcome this situation, the Oak Ridge Institute of Nuclear Studies, through its Special Training Division, offers a 4-week basic training course in radioisotope techniques at the rate of six sessions per year.

Recent development is the production of a series of training films entitled "The Radio-isotope."

. . .

**Edouard Prevost,** Quebec Hydro-Electric Commission, Montreal, also in connection with the article on Practical Radioactivity, posed the following problem:

> The excavation of the Beauharnois power canal is carried out with suction dredges. The pumps which draw the mixture of solids and water from the canal bottom and then push it to shore get tremendous wear from the abrasive character of the excavated material. Every winter, a major overhaul supplements the operational maintenance. We are occasionally faced with the necessity of knowing the thickness of material in worn sections of the pump.
>
> As a consequence, we are interested in a portable apparatus that could be calibrated from a known thickness in the pump and then brought to the spot to be measured. Both sides of said spot are generally accessible.

Editor Kramer in his reply said that unless there were conditions surrounding it, not apparent from the brief statement above, the wear in various sections of the pumps could be measured by means of a gamma gage. As the name implies, the gage utilizes gamma radiation from a radioisotope source such as iridium 192.

A number of firms in the United States sell such gages; and in Canada, Isotope Products, Ltd., markets both the radioisotopes and various types of instruments used in radiation measurement. The company has used the gamma gage in the inspection of such equipment as refinery unit parts which were at such a high temperature (1150 F.), it was impossible even to approach them.

These units were operating at the time of the inspection. Wear from the hot exit gases was suspected, particularly at elbows in pipes and exit flue lines coming from a cracking unit. A source of two curies of iridium 192 was placed at the center of the bend radius and the gamma gage head traversed in a circle at about four feet from the elbow's exterior circumference. A number of runs was made to average out the effects of unusual temperature conditions.

. . .

**E. L. Belknap,** Kay Shingles, Inc., Seattle, who is very enthusiastic about the work of **Frank Browning,** told us:

> I have read with much interest several articles in the July issue of POWER ENGINEERING but especially want to comment upon the article entitled Power Plant Grasp, written by a Frank H. Browning.
>
> I am not an engineer by profession though did study mechanical engineering for three years at the University of Washington. I do not follow engineering as a profession but do use the common sense technique of engineering every day.
>
> Mr. Browning's article is written, I believe, about one of the most common misconceptions in every power plant, whether in a factory or a shingle mill, and it is written in such a way that the average operator can easily understand, just as in his famous booklet Steam Plant Errors that has helped so many boiler operators in Northwest mills. We should like to see more common sense articles by Mr. Browning in future issues of POWER ENGINEERING.

. . .

**E. J. Sullivan,** Erie City Iron Works, Pa., in looking over our recently-published *Power Plant Primer,* wrote to **Editor Andrew Kramer:**

> I have seen your book entitled *Power Plant Primer,* and as yet have only gotten past the first couple of pages. However, the entire book looks as though it has plenty of meat in it, and can be read by almost any lay person and intelligently understood.

**Melvin C. Krampf,** Raymond C. Mayer and Associates, New York, commented:

> Your *Power Plant Primer* is a delight. After reading it I feel like applying for a job as a power engineer. Would there were more technical writers like you. It sure would save wear and tear on us miserable souls who have to read bales of technical papers.

*A Power Plant Primer* can be an excellent source of information for the practical power engineer, to help him explain power plant fundamentals to neophyte engineers, students and the general public. Single copies are available at $1.00 each; quantity prices on request.

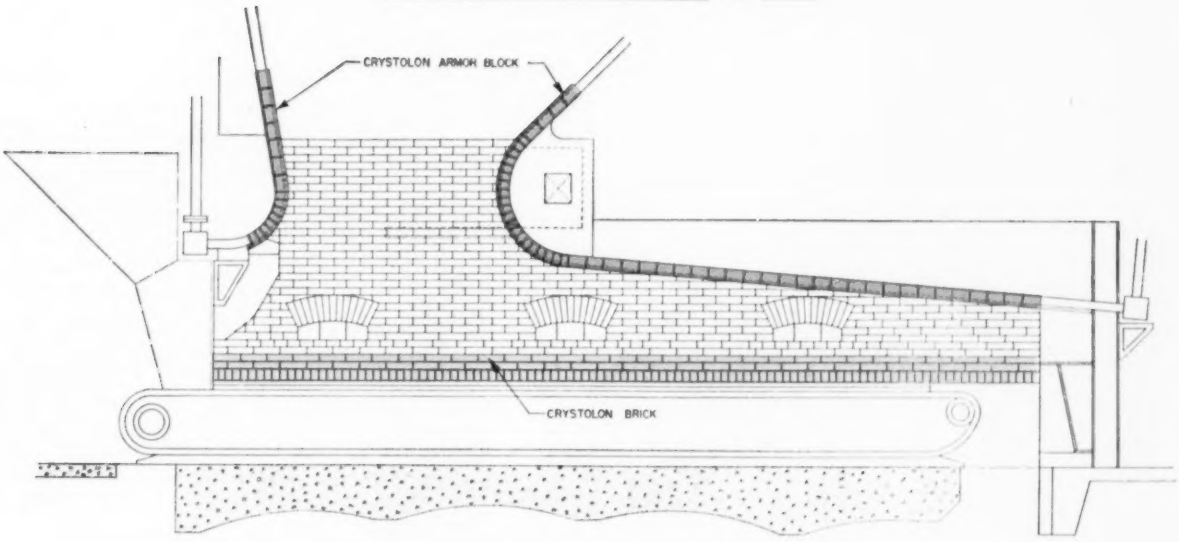
. . .

In answer to a personal inquiry from Brooklyn, N. Y., **Editor Andrew Kramer** remarked:

> As you probably know, at the present time we get the bulk of our uranium from the Belgian Congo. Belgium, it so happens, is relatively poor in coal and oil and she has been putting a great deal of pressure on the United States during the past few years to have us develop technologies which will enable them to use some of that uranium for the production of electrical energy. With the high fuel costs existing in Belgium, this should be no great problem for them. At any rate because of the pressures, the United States is now trying to prove to the world that we are actually engaged in building atomic power plants. Russia is also engaged in the construction of atomic power plants and if she should attain success first, it could well be possible that she could win such countries as Belgium away from us.

It is interesting to note that Great Britain started the construction of an atomic power plant a year and a half ago, and that this plant probably will be in operation long before our plant at Shippingport is finished.

# CRYSTOLON* Refractories give vital protection — *two ways*




## *Norton brick and armor block provide two money-saving Rx's — reduce abrasion and safeguard water tubes*

This diagram of a chain grate, stoker fired boiler shows how abrasion of the setting by moving fuel has been cut to a minimum. Three to five courses of CRYSTOLON brick at and above grate level are all that are needed. The extreme hardness of this Norton *engineered and prescribed* refractory gives the same excellent results where severe flame erosion is encountered.

Above this brick, the diagram also shows how the water tube front and rear arches are protected against hot, swirling gases by CRYSTOLON armor blocks. Their high heat release supports combustion and preheats any infiltrated air from the ash pit entering the main boiler section.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

### *New booklet gives you the whole story*

The above is just one of the applications described in the new Norton 24-page illustrated booklet on *Refractories For Heat and Power*. To learn how these highly efficient, quality-controlled refractories supply a performance-improving Rx for every boiler application, write for your copy today. NORTON COMPANY, 620 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto 5, Ontario.

**NORTON REFRACTORIES**

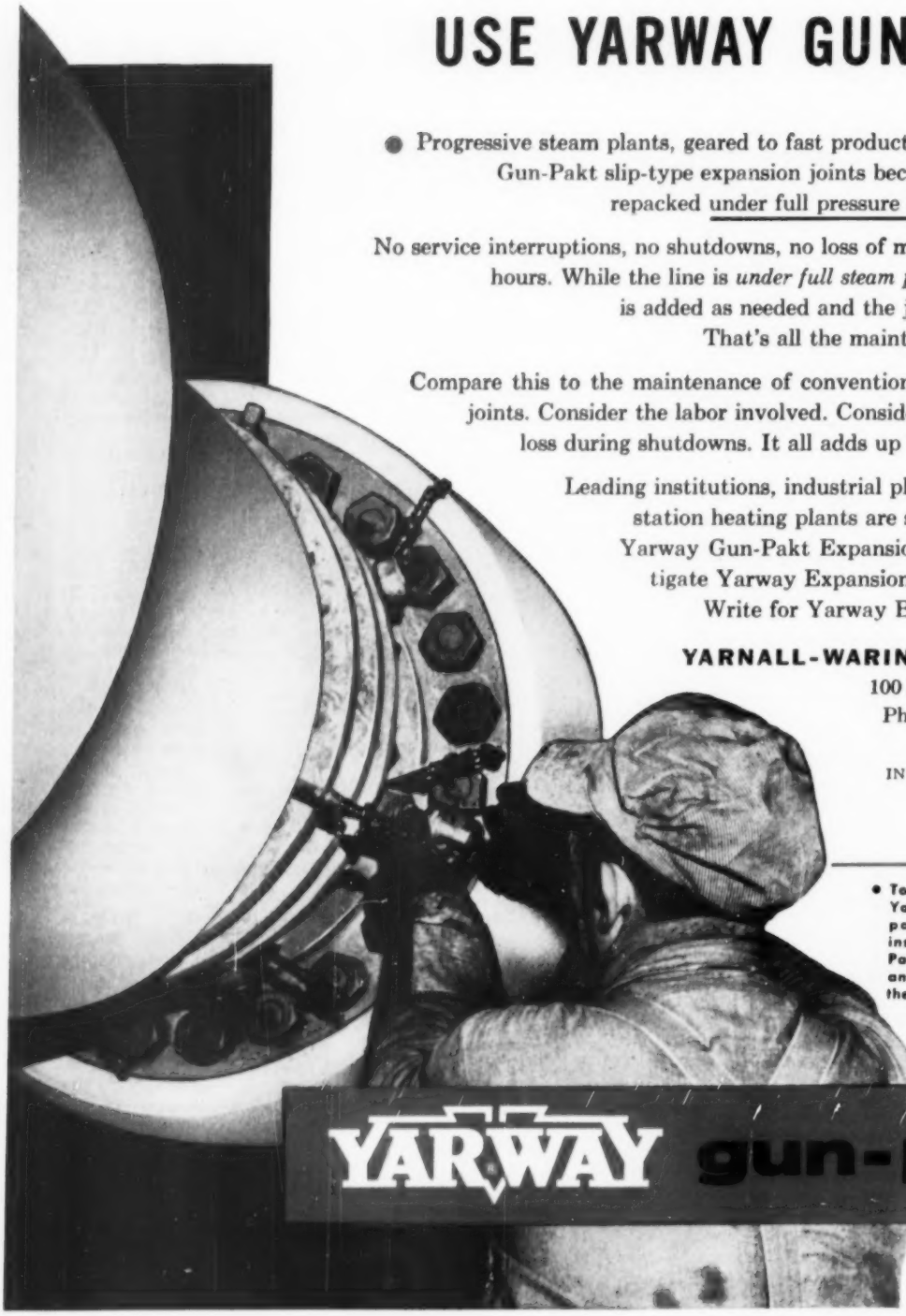
*Engineered . . . Rx . . . Prescribed*

*Making better products . . . to make other products better*

**For more data circle 504 on Post Card**

# going places?

## DON'T BOTHER TO UNPACK..
## USE YARWAY GUN-PAKT



● Progressive steam plants, geared to fast production, use Yarway Gun-Pakt slip-type expansion joints because they can be repacked under full pressure right on the job.

No service interruptions, no shutdowns, no loss of man and machine hours. While the line is *under full steam pressure*, packing is added as needed and the joints lubricated. That's all the maintenance required.

Compare this to the maintenance of conventional gland-packed joints. Consider the labor involved. Consider also the profit loss during shutdowns. It all adds up to GUN-PAKT.

Leading institutions, industrial plants and central station heating plants are standardizing on Yarway Gun-Pakt Expansion Joints. Investigate Yarway Expansion Joints yourself. Write for Yarway Bulletin EJ-1913.

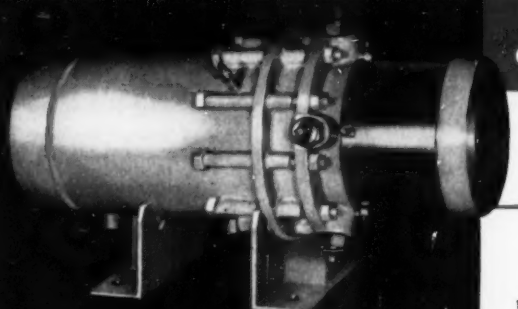
**YARNALL-WARING COMPANY**
100 Mermaid Avenue
Philadelphia 18, Pa.

BRANCH OFFICES
IN PRINCIPAL CITIES

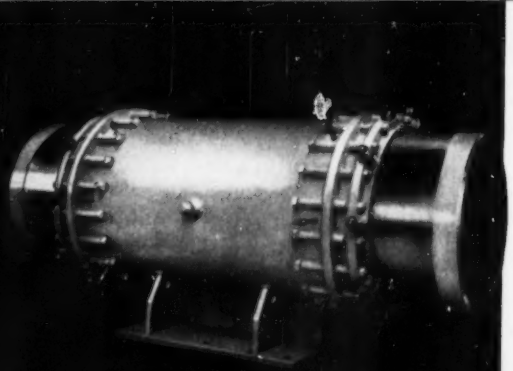
● To add packing to a Yarway Gun-Pakt Expansion Joint, just insert Yarway Plastic Packing, twist a wrench and the joint is tight . . . the job done. *There is no unpacking operation.*

YARWAY gun-pakt

# EXPANSION JOINTS



Single end, welding-type Yarway Gun-Pakt Expansion Joint with base for pressures to 300 psi. 12 inch traverse.



Double end, welding type Yarway Gun-Pakt Expansion Joint with base for pressures to 300 psi. 24 inch traverse.

## compare these maintenance records

| | YARWAY GUN-PAKT JOINTS | CONVENTIONAL GLAND-PACKED JOINTS |
|---|---|---|
| STATE UNIVERSITY* | Required addition of only 3 slugs (45 cents) of packing in 5 years. Lubrication only once every 6 months. Total labor time of only 2 manhours in 5 years. | Same lubrication as Gun-Pakt, *plus* gland tightening, *plus* complete overhaul with shutdown for unpacking and repacking every 3 to 4 years. Time for overhaul—25 manhours per joint! |
| MID-WEST AIRFIELD* | Only maintenance was lubrication and addition of 2 slugs (30 cents) of packing per year. Total labor ¼ manhour per joint per year. | Lubrication and gland tightening required 8 manhours per joint per year—plus complete unpacking and overhaul every 2 to 3 years. Time required for overhaul—20 manhours per joint. |
| "BIG TEN" UNIVERSITY* | Lubrication only once every 2 months, with packing added as needed. Total labor time charged, 1 manhour per joint per year. | General maintenance requires 6 manhours per joint per year. Complete overhaul required every 2 to 3 years with unpacking and repacking—24 manhours per joint. |

*Names on request

**WHAT'S NEW AT YARWAY?**

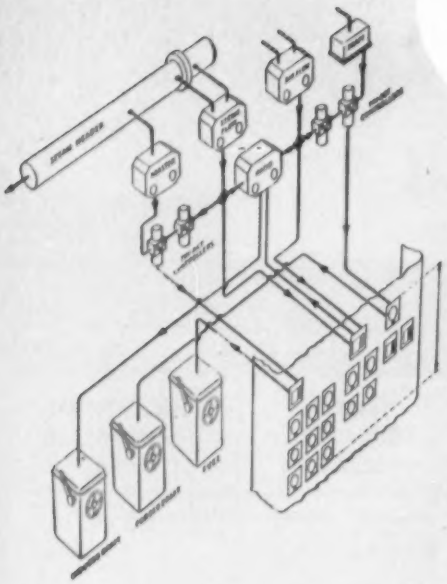
**See the Yarway Exhibit, Booths 513-517 at the National Power Exposition in Philadelphia, Dec. 2-7.**

**expansion joints**

**OTHER YARWAY PRODUCTS**

**BLOW-OFF VALVES**
**WATER COLUMNS AND GAGES**
**LIQUID LEVEL INDICATORS**
**IMPULSE STEAM TRAPS**
**FINE SCREEN STRAINERS**
**SPRAY NOZZLES**
**DIGESTER VALVES**
**HYDRAULIC VALVES**

**For more data circle 505 on Post Card**



COPES VULCAN offers

## COMBUSTION CONTROL

**You can save fuel, labor and maintenance dollars by installing modern Copes-Vulcan combustion control.**

**You can be sure of:**

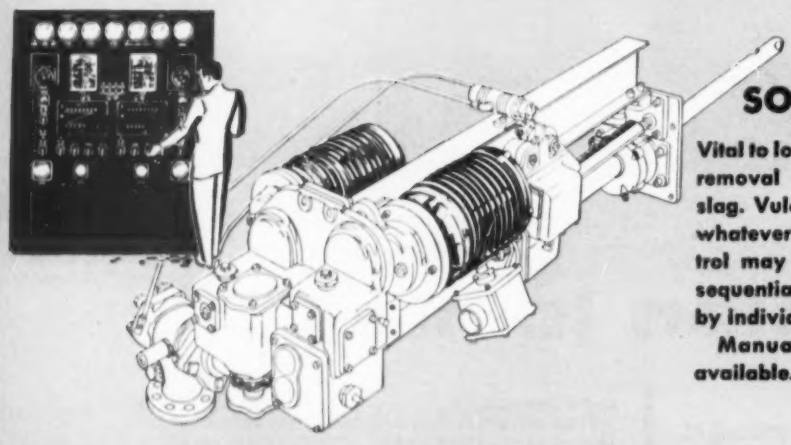
**—highest combustion efficiency**
**—constant furnace pressure**
**—constant steam pressure and temperature**

***Bulletin 1007-A* describes this new approach to boiler control through**

C·V+T=BBC

COPES·VULCAN+Taylor=BETTER BOILER CONTROL

**Reduce** your steam costs. Get more efficient and safer boiler operation. Use one or more of these four Copes-Vulcan aids to offset rising costs of fuel, labor and maintenance. C • V + T offers a new approach to boiler control—with undivided responsibility from analysis to installation—and service wherever needed for the life of the installation.



## SOOT BLOWING

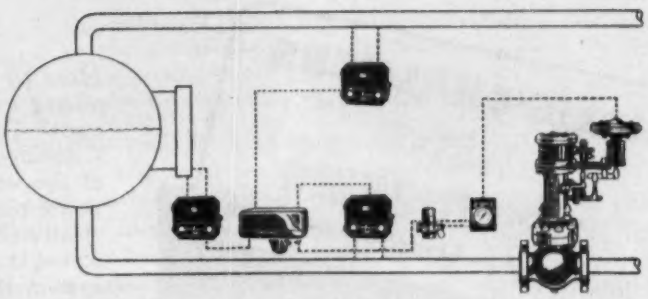
**Vital to lower steam costs is the regular removal of soot, sintered dust and slag. Vulcan does this job effectively, whatever the size of your boiler. Control may be automatic or automatic-sequential—through central panel or by individual push buttons.**

**Manually-operated blowers are available. *Write for Bulletin 1001.***

# 4 aids to lower steam costs

## FEED WATER CONTROL

**Copes feeds exactly as needed to maintain correct water level while meeting steam demands. Three-, two- or one-influence systems are available for your specific needs. Control may be independent, or tied in with combustion control. Take a look at the newest three-influence COPES instrument-type feed water control system—Type 3-L, described in *Bulletin 1013.***

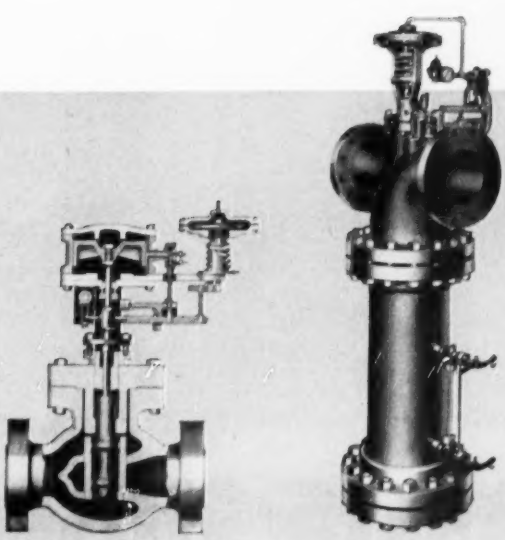


**COPES-VULCAN DIVISION**
CONTINENTAL FOUNDRY & MACHINE COMPANY
**ERIE 4, PENNSYLVANIA**

## REDUCING and DESUPERHEATING

**Copes Reducing Valves have ports characterized for specified flow and pressure conditions. Rugged construction throughout. *Write for Bulletin 477-A.***

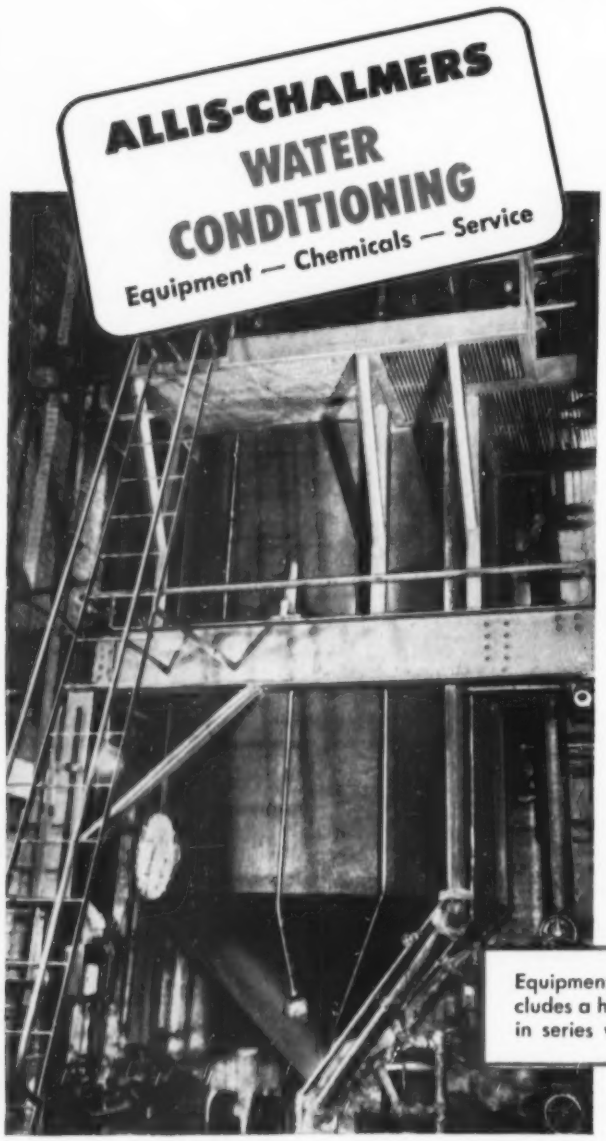
**Copes Desuperheaters are self-contained, need no "extras" for installation. Temperature control is accurate, even on lightest flows, because cooling water is fully controlled inside the chamber. *Bulletin 405-C.***



**For more data circle 506 on Post Card**

## Minneapolis Gas Co., Minneapolis, Minn., Gets...

# MORE BOILER FEEDWATER




*How to increase feedwater supply* without adding excessively to chemical and equipment costs? That was the problem at Minneapolis Gas Company, Minneapolis, Minn., when installation of new equipment increased demands on the power plant.

Allis-Chalmers water conditioning engineers solved this problem with a hot lime, ion exchange system that provides zero hardness, extremely low silica content, low alkalinity and low $CO_2$ in steam. Chemical costs are very reasonable, since only salt and lime are needed. An added dividend can come from the small amount of space required for equipment — for example, in one installation of this type, the resin tanks are tucked under the basement stairs.

### Solve Any Water Problem

You can find a solution to any water conditioning problem by consulting with an Allis-Chalmers water conditioning expert. Allis-Chalmers will provide analysis and a complete recommendation, in addition to supplying you with the chemicals and equipment you need.

*If you would like to learn more* about the hot lime, ion exchange process outlined above, get a copy of Allis-Chalmers Water Conditioning Informational Bulletin 49 from your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4403

Equipment similar to this at Minneapolis Gas Co. includes a hot process lime-soda softener which is placed in series with the hot zeolite (ion exchange) unit.

**ALLIS-CHALMERS**

For more data circle 507 on Post Card

*Sure, that old pump still works,*

**but how much does it cost to keep?**

That rugged old pump of yours may not be the bargain that it seems. Let's do some arithmetic. If the efficiency of the old pump is 75% vs. the 85% efficiency of the new pump, you are paying more to keep it than you would to replace it. That's because a new unit of equivalent output uses less power. Thus it soon saves its own cost — then begins to pay dividends.

**Let's take a specific example — a small boiler feed pump**

**Old pump efficiency 63% . . . . . 99.5 BHP**
**New pump efficiency 69% . . . . . 91.0 BHP**
**8.5 BHP Saving**

**On the basis of 1¢ per KWH, the 8.5 BHP saving for 8,760 hours (a year of continuous operation) amounts to $560. This saving, capitalized in 10 years at 4%, adds up to $6,700. Yet the price of the new pump that saves $6,700 is only $1,101.**

What would the pump replacement profit be in your particular case? Your De Laval representative can tell you exactly — in dollars and cents — as soon as he has the basic facts on your present installation. Call him in today or write to De Laval for Pump Fax Bulletin which includes a valuable "power-savings" chart.

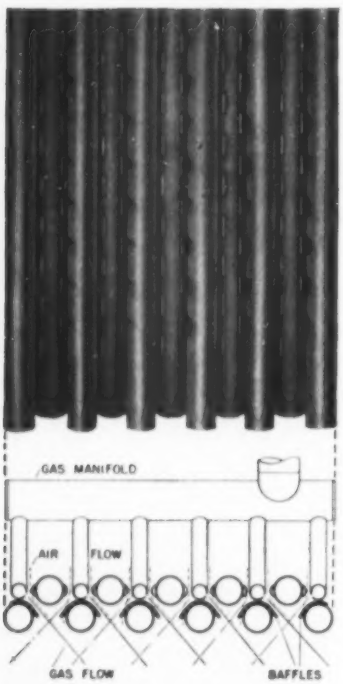
**DE LAVAL** *Pumps*

**DE LAVAL STEAM TURBINE COMPANY**
*816 Nottingham Way, Trenton 2, New Jersey*

01297

**For more data circle 508 on Post Card**

# Modern... Outdoors...




Section of Riley Intertube Burners shows tube arrangement and baffles. Drawing illustrates how gas pipes are protected by water tubes while baffles welded to front tubes assure positive and uniform mixing of gas and air.

**View of lower boiler drum open at ends showing Riley submerged type heat exchanger.**

Two new Riley pressurized furnace steam generating units, installed in a Texas chemical plant are operating at high efficiency. The design is completely modern in concept: induced draft fans have been eliminated, new Riley Intertube Burners for firing natural gas are used for the first time, and special considerations have also been made to insure low cost, clean steam from feedwater high in solids and silica content.

**A Few of the Outstanding and Exclusive Riley Design Features of these Twin Riley 200,000 pounds per hour Pressurized Furnace Units**

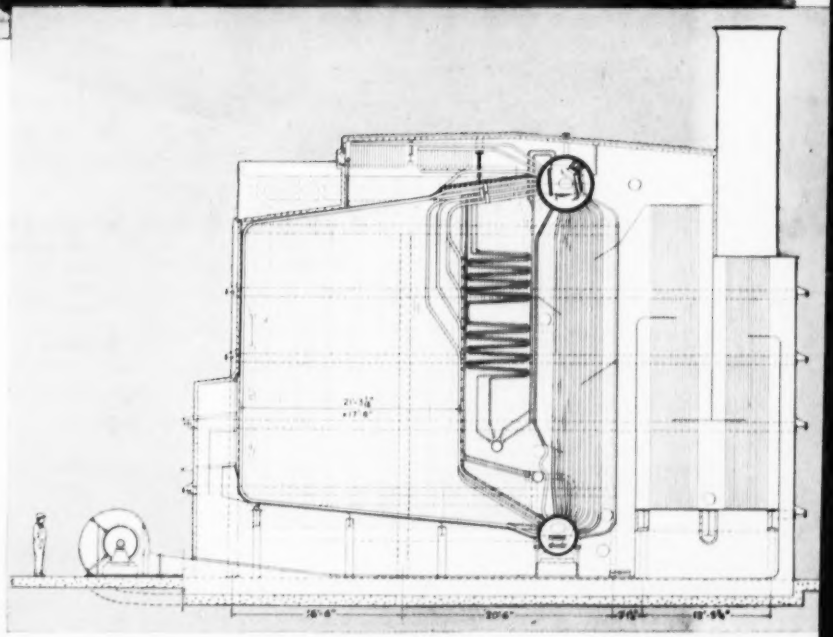
- Insulation over an all-welded inner casing is "plasticized" to resist weathering.
- All waterwall tubes are welded to stub tube ends in headers, not rolled.
- Compact design of hot and cold air ducts permits low cost installation of forced draft fans.
- New Riley Intertube Burners for firing natural gas make possible low excess air and also do away with exposed burner refractory, resulting in complete elimination of furnace refractory maintenance.
- "Wall of Flame" characteristic from this new Riley burner provides unusual uniformity of heat distribution across furnace with uniform heat absorption across superheater.
- The effectiveness of the Riley Condenser Type Steam Purifier in main steam drum produces the unusual steam purity of only 0.33 ppm solids and 0.010 ppm silica in spite of boiler water concentration as high as 4000 ppm solids and 94 ppm silica.
- A submerged type Riley heat exchanger in lower drum provides constant steam temperature over a wide load range.

When steam generating equipment must be "tailored" to meet specific requirements, you too will find Riley engineers thoroughly qualified to fill your needs. A survey of your power plant requirements by a consulting engineer will possibly show you ways of making surprisingly large savings in your power costs.

**For more data circle 509 on Post Card**

# Pressurized!

This completely outdoor plant has Riley gas burners and f-d fans at front wall of boiler. Control room, center, is the only enclosed part of plant. Operators have clear view of all auxiliaries in 40′ wide aisle between boilers, also of turbines at left of control room. Note absence of structural steel.



## ENGINEERING DATA

**Maximum Continuous Capacity—each unit—200,000 lbs./hr.**
**Design Pressure—1075 psig**
**Operating Pressure—1000 psig**
**Superheater Temperature—850F**
**Furnace Volume—10,000 cu. ft.**
**Furnace Height—30′-6″**
**Furnace Width—17′-8″**
**Furnace Depth—21′-3/16″**
**Heat Release in Furnace Btu/cu. ft./hr.-29,900**
**Riley Cross Flow Air Preheater—38,000 sq. ft. surface**
**Eight Riley Intertube Burners**
**Efficiency—each unit—83.1%**

# RILEY Stoker Corporation

WORCESTER, MASSACHUSETTS

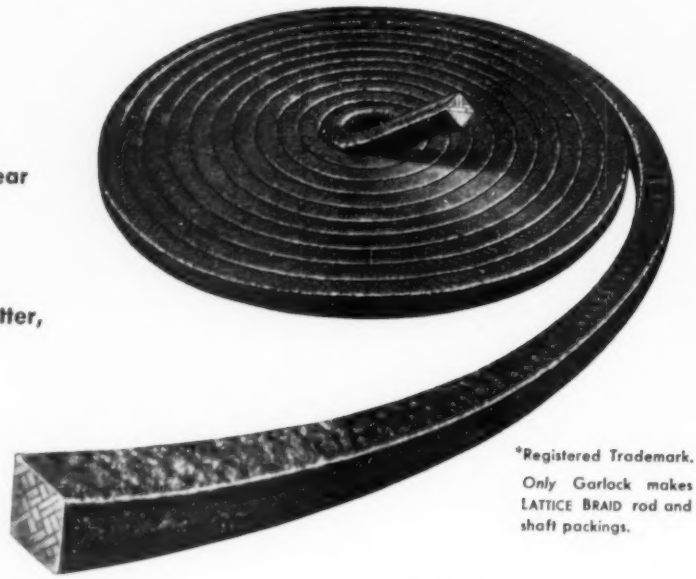
Boston New York Philadelphia Buffalo Washington Pittsburgh Cleveland Detroit Chicago Cincinnati Charlotte New Orleans
Atlanta St. Louis Kansas City St. Paul Tulsa Houston Denver Salt Lake City Los Angeles San Francisco Portland Seattle

## COMPLETE STEAM GENERATING UNITS

AND FUEL BURNING EQUIPMENT FOR PUBLIC UTILITIES, INDUSTRIAL POWER AND HEATING PLANTS

# Service Reports show that LATTICE BRAID* Packing has these 5 Big Advantages over ordinary braided packings:

1. Requires *less* gland pressure
2. Causes *less* sleeve and shaft wear
3. Retains lubrication *longer*
4. Does *not* unravel; thus makes better, more uniform rings
5. Lasts *much* longer



*Registered Trademark.
*Only* Garlock makes LATTICE BRAID rod and shaft packings.

Put Garlock LATTICE BRAID Packing to work for your company. All the braided strands of this unique packing are lattice linked together into one structural unit. The strands hold together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

LATTICE BRAID is made from flax, cotton, asbestos, wire-inserted asbestos, Teflon, and asbestos with Teflon impregnation—for various types of services.

Get all the facts about LATTICE BRAID Packings. Contact your Garlock representative or write for new folder AD-131.

## TYPICAL SERVICE REPORTS

▶ **SEWAGE DISPOSAL PLANT**—On sewage pumps handling sludge and grit, 80 to 125 p.s.i., 7/16" and 1/2" packing. Both Garlock 733 and 740 LATTICE BRAID Packing hold together better, retain lubricant longer, and cause less shaft wear than previous packings. In addition, LATTICE BRAID lasts 4 times longer.

▶ **PAPER COMPANY**—On defibrator handling water and wood pulp, 175° F., 200 p.s.i., 3/4" packing. Best service from previous packing was 2 weeks. Garlock 733 LATTICE BRAID Packing lasts 13 weeks.

▶ **MEAT PACKER**—On circulating pumps (centrifugal) handling water, 55° to 80° F., 40 to 250 p.s.i., 3/4" packing. Customer prefers Garlock 732 LATTICE BRAID Packing for this service because it does not unravel and because it makes better, more uniform rings.

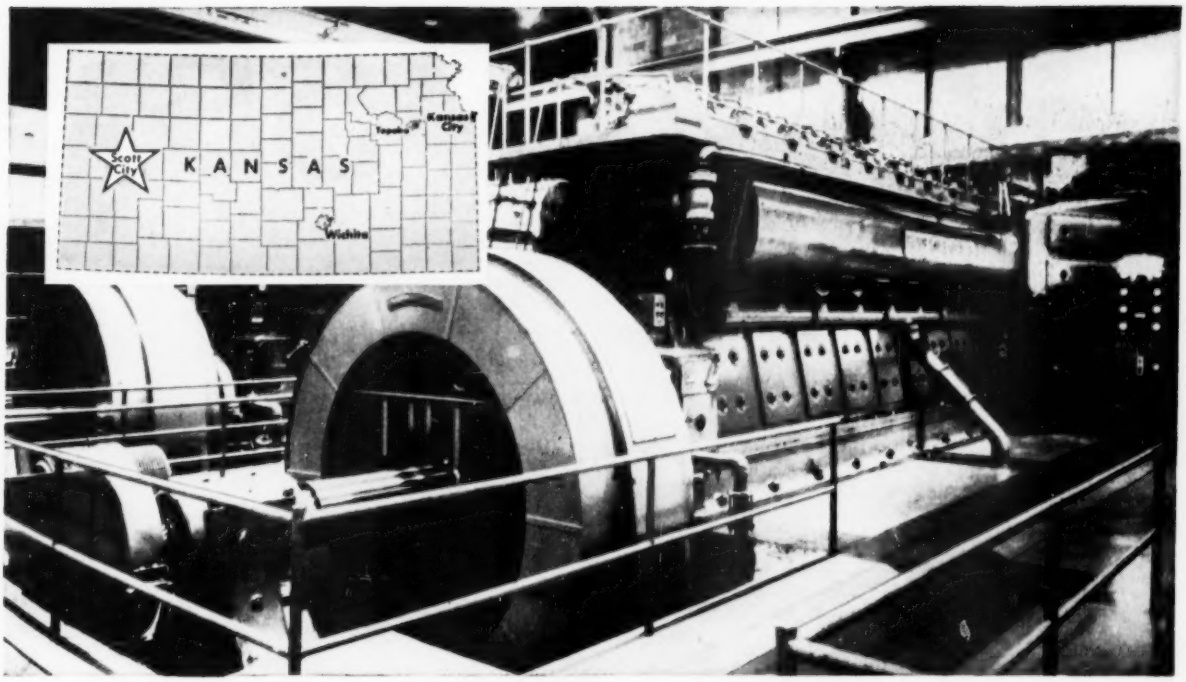
**THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK**

**Sales Offices and Warehouses:** Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N. Y.) • Philadelphia • Pittsburgh • Portland (Ore.) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

**In Canada:** The Garlock Packing Company of Canada Ltd., Toronto, Ont.

# GARLOCK LATTICE BRAID PACKING

**For more data circle 510 on Post Card**

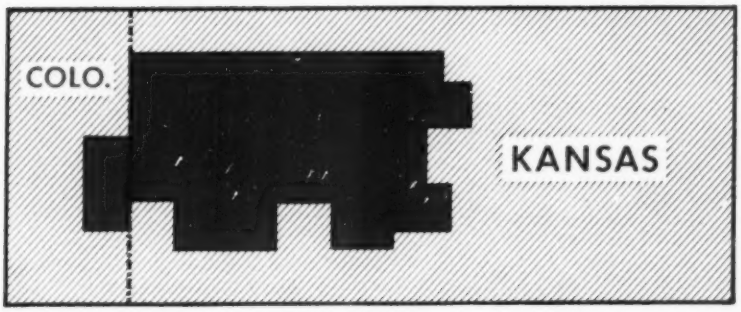



# Largest REA Plant in Kansas Reports Cities Service DC-840 Diesel Oil Excellent!

Fairbanks-Morse Diesels of Wheatland Electric Cooperative, Inc. give outstanding performance using DC-840 Oil for power cylinder and crankcase lubrication. Here are the results Wheatland achieved:

**1.** House operation each unit—13,000 hours.
**2.** No oil changes due to oil failure.
**3.** No overhaul or major breakdown.
**4.** Rings free in groove with little or no signs of wear.
**5.** Oil consumption within mfgr's. recommendation.
**6.** Fuel consumption 10,572 BTU/KWH, load factor 63.7%.
**7.** Maintenance of lubricating oil at minimum expense.
**8.** 3500 H.P. hours per gallon of lubricating oil.
**9.** No wear on main or rod bearings.
**10.** No oil change at end of 9,000 hours.

For similar results in your Diesel operation, contact your nearest Cities Service office or write to Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.



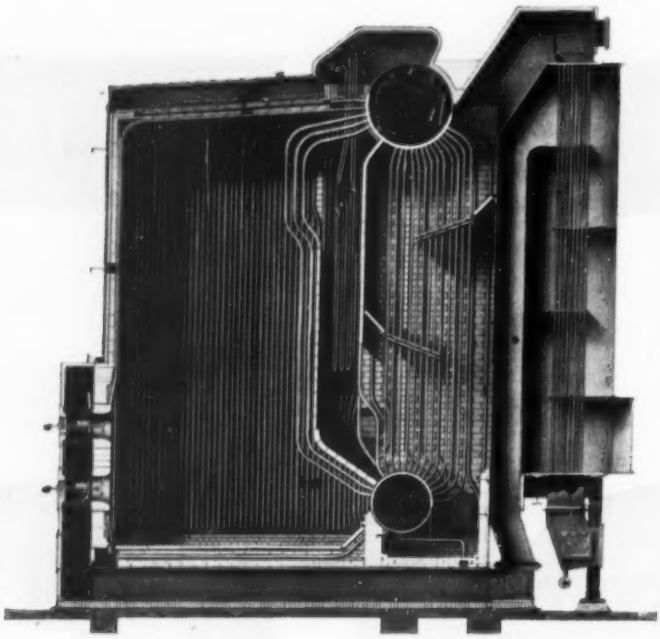

**WHEATLAND ELECTRIC COOPERATIVE, INC.** serves 3,300 square miles in all or part of Scott, Wichita, Hamilton, Greeley, Kearny, Wallace, Logan and Finney Counties in Kansas as well as sections of Kiowa and Prowers Counties in neighboring Colorado. Also supplies wholesale the Lane-Scott Cooperative serving 2,200 square miles in 6 Kansas Counties.

CITIES SERVICE

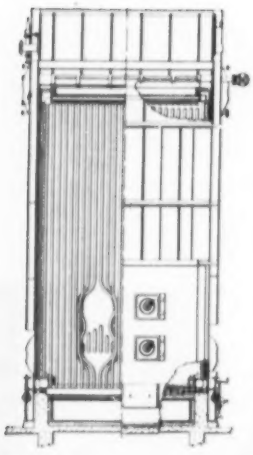
QUALITY PETROLEUM PRODUCTS

**For more data circle 511 on Post Card**

# THE VU-55---



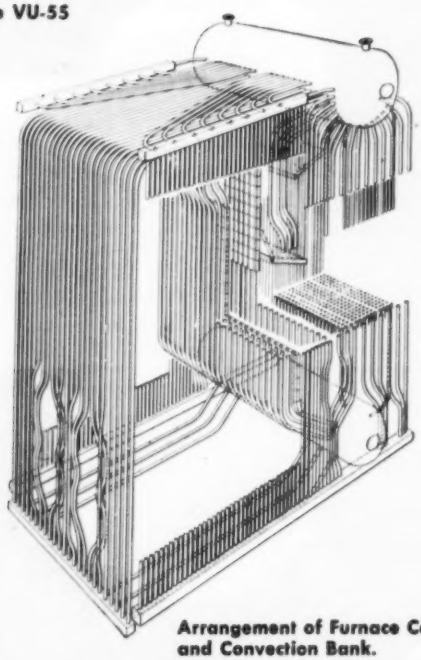
**C-E Vertical-Unit Boiler, type VU-55**



**Front Elevation**

***SPECIFICATIONS***

**Sizes**—Six sizes ranging from 50,000 to 120,000 lb of steam per hr.
**Pressures**—250 to 500 psi (all sizes)
**Temperatures**—as required up to 750 F
**Fuels**—oil or gas
**Heat Recovery**—Tubular Air Preheater



**Arrangement of Furnace Cooling and Convection Bank.**

# A NEW MEMBER OF THE VU FAMILY

## . . . for steam requirements from 50,000 to 120,000 lb per hr

One of the most important size groups of industrial boilers is that comprising capacities ranging from 50,000 to about 100,000 pounds of steam per hour.

Combustion Engineering has designed a boiler unit especially suited to the modern requirements of that capacity range. It is the Vertical-Unit Boiler, Type VU-55, here illustrated and described.

Developed with the same background of experience and engineering competence that is responsible for the service-proved success of Combustion's VU-family of boilers, the VU-55 offers numerous advantages to anyone whose steam needs fall within its application range. The more important of these advantages are:

## ADVANTAGES

**FURNACE ARRANGEMENT** – The VU-55 is designed specifically for firing with oil or gas fuel. The furnace is high; the burners are set low in the front wall. The resultant long flame travel assures adequate mixing and proper combustion.

**SYMMETRICAL DESIGN** – Each transverse section through the VU-55 Boiler is the same as every other. Furnace gases flow across the surface of each section in equal amounts and at the same relative temperatures. Each section, therefore, absorbs the same amount of heat – produces the same amount of steam. Expansion of pressure parts is uniform; steam is released evenly across the length of the drum; water level is steady. Result – unit can carry high sustained demands or rapid load swings without pressure loss or effect on steam quality.

**STEAM QUALITY** – Equipped with a large (60-in.) steam drum, the VU-55 has generous water capacity and steam reservoir space. In addition C-E drum internals, which reflect many years of development and experience, assure high quality steam at all ratings.

**HIGH HEAT ABSORPTION** – Closely spaced side wall tubes (3 in. dia. on 4-in. centers) plus fully water-cooled front wall not only assure highest heat absorption but reduce furnace maintenance to a minimum.

**STREAMLINED EXTERIOR** – The over-all appearance of the VU-55 reflects the efforts of its designers to achieve a completely unobstructed casing while retaining adequate access wherever required and every facility for convenient operation. There are, for example, no outside downcomer tubes and ducts from air heater to burners are beneath the furnace floor.

***In selecting your next boiler unit please consider this:*** You may be able to buy steam generating capacity for less (first cost) than you'll get with a VU-55. But you can't buy better. It's a matter of record that many – perhaps most – boiler installations cost more for the fuel burned *each year* than the *original cost* of the boiler. Consider, too, that when you buy a boiler you *live with it* for 20 or 30 – or more – years. Looks like the wrong place to select equipment on first cost alone. So – do not fail to investigate Combustion's VU-55. A qualified C-E engineer will be pleased to discuss any details with you or your consultants.

C-E

# COMBUSTION ENGINEERING

**Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.** B-777

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

**For more data circle 512 on Post Card**

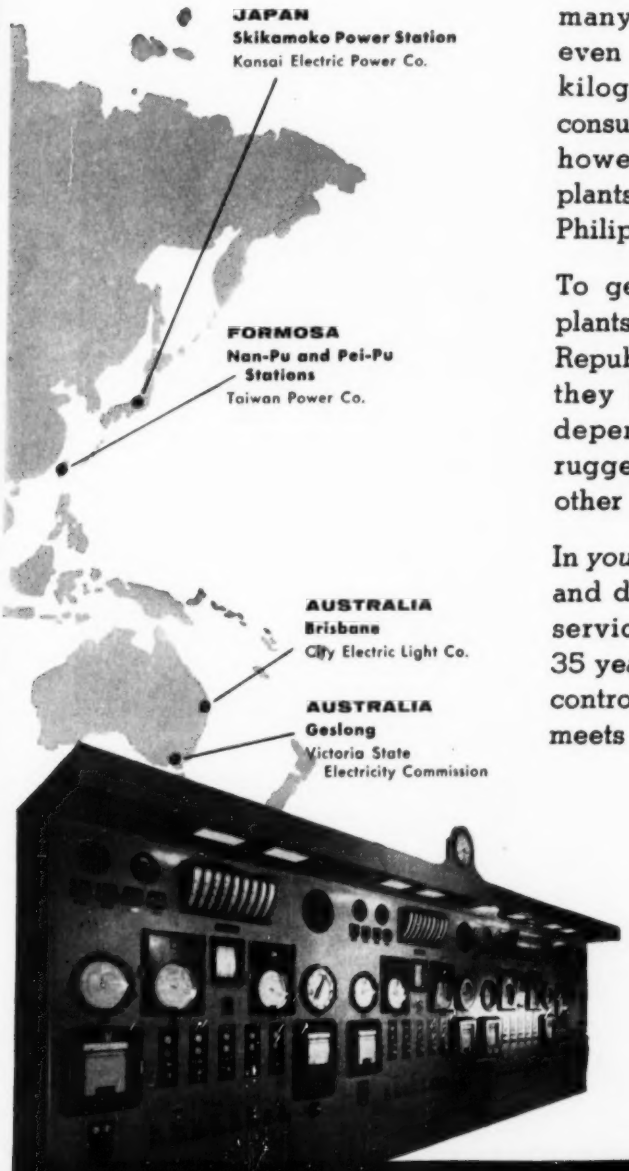
# Choose the Combustion Controls

*THIS IS ONLY A PARTIAL REPRESENTATION OF POWER PLANTS OUTSIDE OF THE UNITED STATES WHICH RELY ON REPUBLIC CONTROLS.*

## REPUBLIC FLOW METERS CO.

# with a World-Wide Reputation

# REPUBLIC *Automatic* COMBUSTION CONTROLS




Combustion efficiency is spelled and pronounced many different ways throughout the world. It's even expressed in two different units — pounds or kilograms of steam produced per unit of fuel consumed. No matter how you spell or measure it, however, its importance is the same to power plants everywhere — in ancient Peru or the distant Philippines.

To get maximum combustion efficiency in power plants all over the world, engineers have specified Republic Controls again and again. With Republic, they know they are getting an extra "plus" in dependability because Republic Controls are ruggedly built to match the high availability of other equipment in the plant.

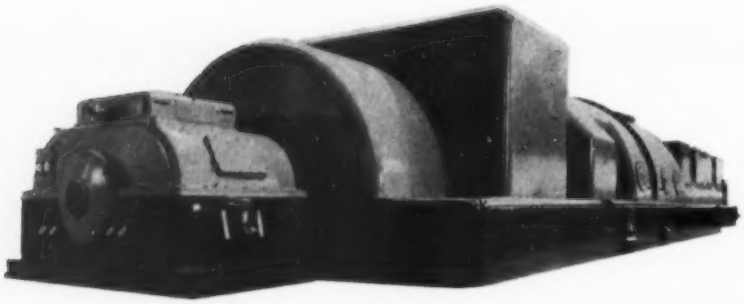
In *your* plant, insure maximum combustion efficiency and dependability by specifying Republic. At your service is an engineering staff with more than 35 years of specialized experience in power plant control to help you design the system that best meets your needs.

**REPUBLIC Automatic COMBUSTION CONTROLS**

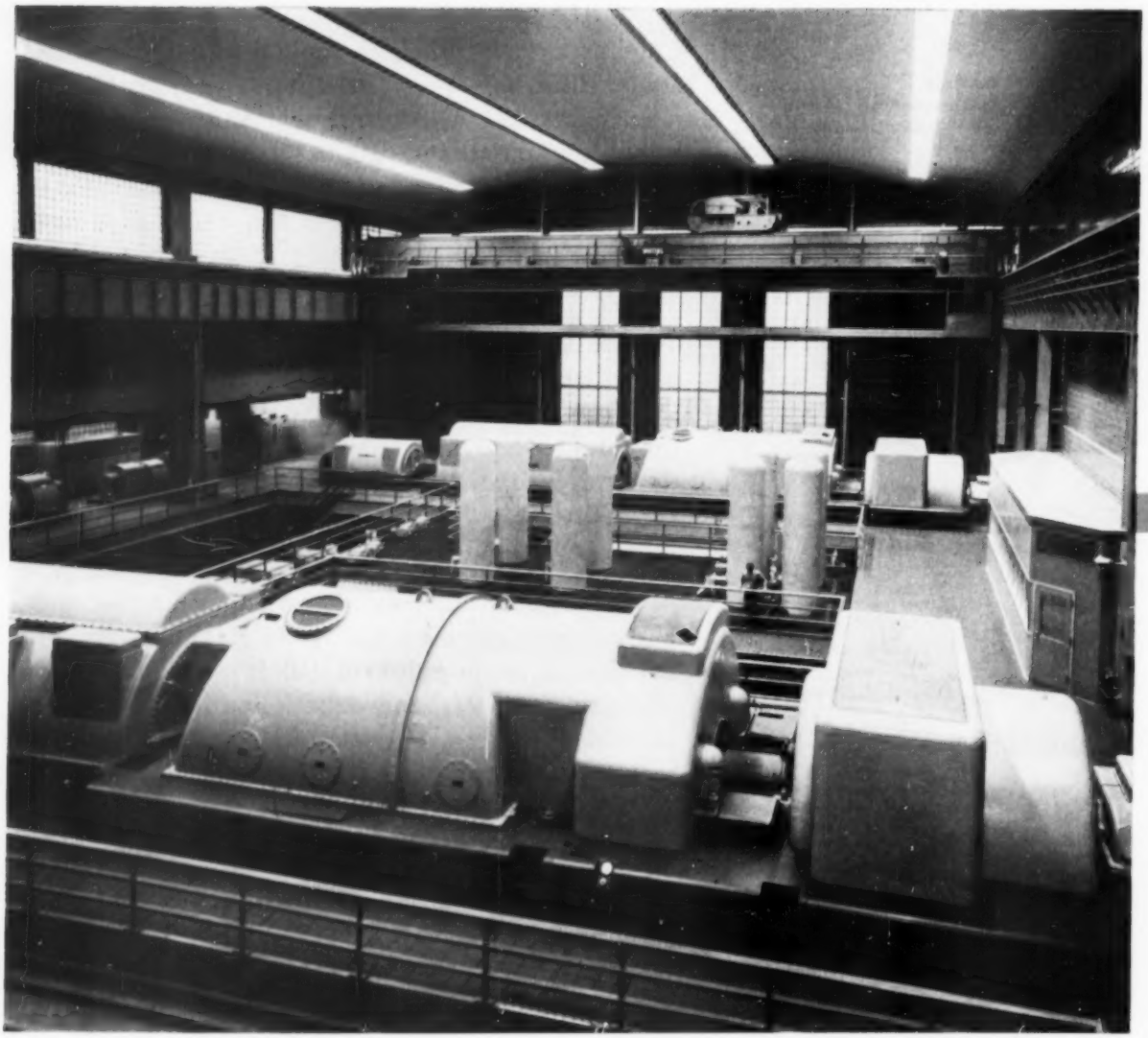
- **For all types and sizes of boilers**
- **For all types of fuel**
- **For all types of firing**
- **For all arrangements of draft**
- **For all load conditions**

**2240 Diversey Parkway • Chicago 47, Illinois**

**For more data circle 513 on Post Card**



# Hottest



Two General Electric 145,000 Kw tandem-compound, triple-flow turbine-generator units at the New Kearny Generating Station of Public Service Electric and Gas Company (New Jersey). They are designed for steam conditions of 2350 psig; 1100 F initial, and 1050 F reheat. At the top is a close-up of one of these high-temperature turbines at the New Kearny Generating Station. These two units produce enough electric power to supply a city of 800,000 people.

# steam turbines in the U.S. get effective, long-lasting lubrication with

# GULFCREST OIL

Driven by steam so hot that the stainless steel pipes carrying it glow dark red and with their huge turbine rotors spinning at 3600 rpm, this country's hottest steam turbines require safe, long-lasting lubrication.

Entrusted with the vital job of providing this kind of lubrication is Gulfcrest—the oil that is super-refined by Gulf's exclusive Alchlor Process.

Gulfcrest Oil's unmatched record of outstanding performance in every type and make of steam turbo-generator is a guarantee of efficient protection for the nation's hottest units for many years to come.

The next time you fill a turbine system, make it a fill for the most effective, longest-lasting protection. Specify Gulfcrest—the world's finest turbine oil. Call your nearest Gulf office today and have an experienced Gulf Sales Engineer recommend the proper grade.

**GULF OIL CORPORATION**

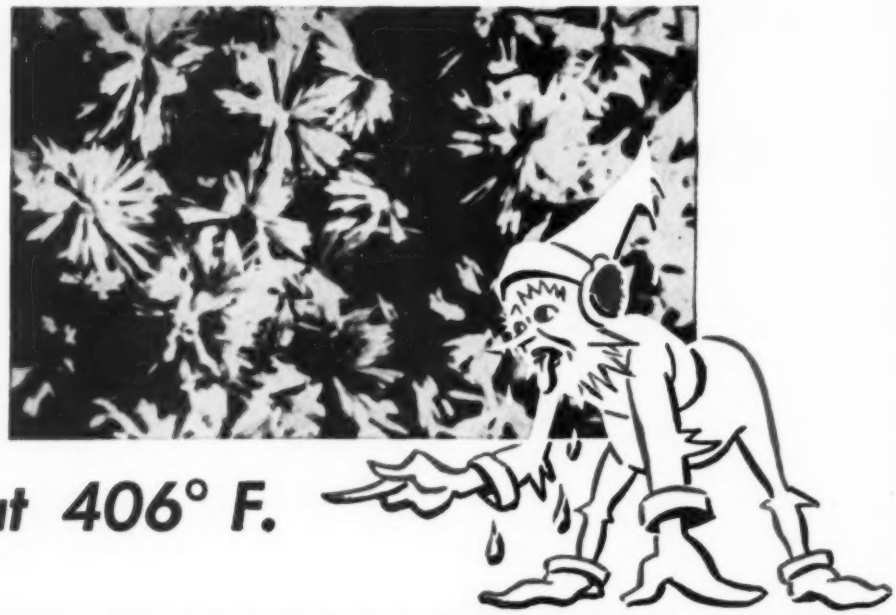
**GULF REFINING COMPANY**

1822 Gulf Building, Pittsburgh 30, Pa.

GULF INDUSTRIAL LUBRICATION

For more data circle 514 on Post Card

# JACK FROST



## at 406° F.

MAGNIFIED fifty times, the calcium carbonate scale in the photo above might easily be mistaken for a frosted window pane. It was formed at 250 p.s.i. in one of the Nalco Laboratories' test boilers as a part of the continuing Nalco research program, aimed at keeping such scales *out* of your power plant equipment.

Whether your feedwater and plant conditions produce this type of scale — or any of hundreds of others — your Nalco Representative has the proved solution for eliminating scale or corrosion from raw water inlet to and through condensate return lines . . . permanently . . . economically. Check with him today — or write direct for fast action on your water treatment problems.

**DO YOU RECEIVE "Nalco ABSTRACTS"?**

**"Nalco ABSTRACTS" is a quarterly publication containing abstracts of general and technical articles of interest to power plant engineers. If you, like most of us, find too little time to read, "Nalco ABSTRACTS" can be of real help in keeping you up-to-date on current developments. Your copies will be sent free upon request.**

**NATIONAL ALUMINATE CORPORATION**
**6224 W. 66th Place • Chicago 38, Illinois**
*Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario*

**THE Nalco SYSTEM...Serving Industry through Practical Applied Science**

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# HELPFUL BULLETINS

## LUBRICATION

**101 Bearing Lubrication** — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved in choice of turbine oils and diesel lubricants, and the deletorious effects of moisture; and the life expectancy of bearing lubricants. The special requirements of porous bearings and applications in which grease lubrication is advantageous are also discussed. The Texas Co.

**102 Lube Service Recommendations** — Application and performance information on a line of industrial lubricants is given in this folder. Covers both non-graphited lubricants and those containing graphite. Included among non-graphited products listed are synthetic zinc oxide lubricants, as well as greases and straight mineral oil types. Gredag Inc.

## PUMPS, COMPRESSORS

**103 Controlled Volume Pumps** — Bulletin 1253, 24 pp, describes and illustrates use of controlled volume pumps as flow controllers, ratio controllers and final control elements in process instrumentation. The first section describes various types of controlled volume pumps and their operation; shows how stroke length and speed adjustment can be effected manually and automatically. The second section contains approximately 20 process flow diagrams of typical applications in many industries. An engineering data section is included. Milton Roy Co.

**104 Vertical Pumps** — Bulletin B-1700, 11-pp, presents four features which distinguish close coupled vertical pumps and suggest their use in transfer of process liquids and water — flexibility of construction; adaptability to pumping system's present available NPSH; space saving design; and availability in both transfer-type and process-type construction. Includes many diagrams. Peerless Pump Div., Food Machinery and Chemical Corp.

**105 Hydraulic Pump** — Complete information on design, installation and operation of an air driven hydraulic pump is given in illustrated Data Sheet 36. Tells how pump is designed to meet demand for small volume capacity at low and high pressures, and develops up to 30,000 psi at 90 psi air supply. Tells how it affords economy of operation for testing tubing, valves and pressure vessels, other applications. The Aldrich Pump Co.

**106 Proportioning Pump** — Six-pp Bulletin AP-54 describes the Hills-McCannameter — a new packless type proportioning pump. Tells what the pump is; what it will do; why it was designed and how it works. Diagrams essential design features and shows how the pump can be used in applications where a conventional pump might prove troublesome. Hills-McCanna Co.

**107 Compressor Maintenance** — Locating troubles in vertical water-cooled air compressors is discussed in Mailer L-676-M1, one of a series of "Trouble Savers" on preventive maintenance designed to help manufacturers reduce their operation costs. Explains reasons for operating troubles as failure to deliver air, insufficient pressure and capacity, vibration. Worthington Corp.

## VALVES

**108 Strainers and Relief Valves** — Eight-pp Catalog Section 12-T presents dimensions and design details for company's forged steel strainers and relief valves, including the newly designed union bonnet strainers in sizes 1¼ in. to 2 in. Gives tips on installation and maintenance and points out its many uses in industry. Edward Valves, Inc.

**109 Pressure Reducing Valves** — Six-pp Bulletin W-3 describes G-A Cushioned water pressure reducing valves, designed to automatically reduce an existing high pressure to a predetermined low pressure. Installation, operation, adjustment, servicing, and specifications are covered. Golden-Anderson Valve Specialty Co.

**110 Rotating Disc Valves** — A line of standard four-way hand, foot, pilot, power, and solenoid operated valves built to operate single or double acting pneumatic and hydraulic cylinders and motors is described in 16-pp Bulletin 1010. Stresses rotating disc construction for longer wear, integral disc and stem for greater rigidity and durability, and variety of controls for most suitable operation. Dimensions and weights, application diagrams, circuit diagrams are included. Ledeen Mfg. Co.

## INSTRUMENTS AND CONTROLS

**111 Valve Controls** — Catalog L-54, 22-pp, describes the LimiTorque control, designed to limit amount of torque applied to valve operating parts and to eliminate need for manual operation of valves. Illustrates and describes the latest LimiTorque SMA valve control for large or small valves; also provides operational details. Power plant and other installations are pictured. Philadelphia Gear Works, Inc.

**112 Controls for Package Boilers** — Specifications for the fully automatic, electric metering type packaged control for shop assembled boiler are given in Bulletin 53-1088-239. Schematic drawing shows typical packaged control system for a combination oil and gas fired boiler. The Hays Corp.

**113 Measuring and Control Equipment** — Various types of control and measuring equipment, for both primary and secondary devices, are illustrated in Bulletin 050. Describes and gives characteristics of standard and elliptical Venturi tubes, as well as parabolic flumes used as primary devices to actuate secondary indicating, recording and totalizing units. Illustrates miscellaneous types of air release and air inlet (vacuum breaking) valves. Simplex Valve and Meter Co.

**114 Pressure Recorders** — Bulletin 6-10, 24 pp, describes a line of pressure instruments designed for direct measurement, remote transmission and automatic control. An application chart shows wide choice of element materials available. Exact ranges are listed for each material and type of element. Bulletin also describes case and linkage features, lists charts for standard process ranges, and covers accessories. The Foxboro Co.

**The new and revised publications reviewed on these pages offer help on many operating and maintenance problems. To order them, use the Reader Service Cards on pages 117-118**

**115 Improved Electric Telemetering** — Instrumentation Data Sheet 9.1-9a describes improved electric telemetering equipment for high speed transmission of system variables to a central location. Tells how company's Electronic indicating, recording and totalizing instruments can be incorporated at various points in system. Tells how transmitter and receiver are interconnected by microwave equipment, power line carrier facilities or two-wire connecting line. Minneapolis-Honeywell Regulator Co.

**116 Liquid Level Gage** — Catalog 246, 8-pp, covers in detail company's three standard types of convex scale and flat scale Truscale remote reading gages, showing how they protect equipment by bringing the liquid level down to where it can easily be seen. Included are features of design and construction; description and schematics of operation; charts illustrating three types of datum columns; descriptions of typical applications; and information on alarms. Jerguson Gage & Valve Co.

## ELECTRICAL

**117 Commutator Motors** — Catalog EI-2A offers a quick reference to electrical and physical characteristics of company's line of Elinco commutator motors, as well as governor units. The 22-pp brochure includes sections on field, shunt, and universal wound motors, as well as permanent magnet and separately excited types. In addition, performance curves, dimensional drawings and specifications are given for each type listed. Electric Indicator Co.

**118 Electric Motor Control** — Containing engineering and design data including wiring diagrams, Catalog 101, a 140-pp book on electric motor control is divided by major product classifications, and lists more than 2700 items including magnetic starters, combination starters, control panels, etc. Book contains photographs, descriptions and prices. Furnas Electric Co.

**119 Electric Motor Test Data** — The selection of electric motors on the basis of certified performance tests is the subject of this paper. Information is presented in tubular form for engineering performance, comparison as to what the results indicate in relation to use. Electro Dynamic Div., General Dynamics Corp.

**120 Subway Distribution Transformer** — Construction features and mechanical data for a new line of subway distribution transformers available in ratings of 15 to 167 kva, single-phase, and 15 to 150 kva, three-phase, 15,000 v and below, are given in 6-pp Bulletin 61B633A. Points out that the transformers incorporate Curvacore design resulting in weight reduction, and can withstand complete submersion. Allis-Chalmers Mfg. Co.

**121 Industrial Relays** — This series of data sheets, Circulars 1801–1805, gives detail descriptions on a line of industrial relays, plug-mounted for advantages in assembly, inspection, servicing, and maintenance. Dimensional drawings, wiring diagrams, and specifications are provided for plug-mounted classes A, B, F, S, and Z relays. Automatic Electric Sales Corp.

**122 Tools of Automation** — Combining applied engineering, creative thinking, and electric motor drives to provide the know-how for automation of single machines or continuous processes is the subject of this 12-pp booklet. Illustrations and sketches accompany each section to help tell the story. Individual booklet divisions illustrate the combination of motors and creative engineering as an aid to choosing the right motor for the job; adjustable-speed drives as a tool of automation; and electronic controls and regulators that provide precise, accurate motor drive operation. Reliance Electric and Engineering Co.

**123 Electrical Insulating Materials** — Of special interest to power engineers, 48-pp Catalog 54 provides helpful information on wire and tubing, an appendix which defines technical terms, and tables of insulation resistance temperature coefficients and temperature conversion. Contains specific data concerning wires and cables, plastic tubing, coated tubing and sleeving, and identification markers. Product performance and specifications are given, also complete ordering information. Pictures and diagrams show applications. The William Brand and Co., Inc.

**124 Corona Test Sets** — Information on corona testing equipment for nondestructive evaluation of electrical insulation is presented in 8-pp Bulletin 66. Describes general principles upon which tests are based. Discusses method of evaluating a series of pulses and how it is applied in the testing apparatus. Various models of the test set are described and specifications given. James G. Biddle Co.

**125 Radio, Electronics Parts** — This 308-pp 1955 edition of this catalog of radio and electronic parts puts special emphasis on equipment for industrial maintenance and other requirements. Contains detailed listings of standard and special-purpose electronic tubes, test instruments, voltage stabilizers, transformers, resistors, capacitors, transistors, power supplies and a wide variety of other electronic equipment and components. Featured is the RCA TV Eye, a moderately-priced remote control television camera for remote observation of processes, for guarding plant entrances and exits, and for safety control. Lists PA equipment for every industrial application. Allied Radio Corp.

## . . . Outstanding Among This Month's Catalogs . . .

**126 Steam Turbine Trends** — Today's trends in steam turbine design is the subject of 6-pp Bulletin 03R8182. Discusses development of close-coupled cross-compound turbines for large capability applications; the rapid increase in size of available 3600 rpm tandem machines; and the widespread application of reheat for improved turbine performance. Calls attention to use of optimum size exhausts for reducing leaving loss and to development of more compact machines to obtain benefits of reduced investment in building, foundations. Allis-Chalmers Mfg. Co.

**127 Electrical Distribution Systems** — "Cornerstone — or Tombstone," a 24-pp booklet on electrical distribution systems for commercial buildings, points out advantages of matching modern services with modern electrical power — service continuity, good performance, safety, and flexibility. Basic elements of an electrical distribution system are described in nontechnical language. Simple diagrams and sketches show how these elements fit together to provide a planned electrical system. Special section presents four typical systems for modern buildings — low-voltage radial, high-voltage radial, spot network, and distributed network. Westinghouse Electric Corp.

**128 Boiler Baffles** — Recent data on design of modern boiler baffles for streamlined flow of combustion gas over heat-absorbing surfaces is presented in 20-pp Bulletin BW-54. Shows more than 30 boiler-setting plans, with an analysis of how each arrangement of tubes is baffled. Material covers every basic boiler construction and numerous variations of each design. One section is devoted to baffle design principles on both new and old boilers, with comments on cross flow of gases over boiler heating surface, and tapered gas passes to compensate for reduced temperature of gasses travelling from furnace to stack connection. The Engineer Co.

**133 Multi-V Belt Handbook** — Featuring a guide to the design of standard and high capacity drives, this 76-pp engineering handbook provides new rating tables which approximate actual operating conditions. They permit design or re-design of V-belt drives at lower cost by reducing the number of belts needed and indicating potential use of lower cost sheaves. Tables cover speed ratings from 100 to 6000 fpm. Other subjects treated include selection, installation and care of V-belt drives, principles of V-belt design. Simplified tables cover such aspects as installation and take-up allowance. Available to qualified power engineers, please state your job title when requesting it. The B. F. Goodrich Co.

**134 Refractory Concrete** — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Charts and tables afford easy reference for technical data. Information contained in company's previous booklets included. Universal Atlas Cement Co.

## BOILERS, FURNACES

**129 Automatic Boilers** — Bulletin BE-4 describes operation and advantages of Continental Automatic boiler's spinning gas technique — a method of obtaining maximum heat transfer with a simplified design. Bulletin shows cut-away view of boiler construction; illustrates hinged doors and method of injecting air into burner. Boiler Engineering & Supply Co., Inc.

**130 Efficient Little Boiler** — Bulletin AD-135 describes company's CB 50–80 boilers available in 50 to 80 hp (15 to 150 lb steam, 30 lb hot water) for heating and processing. Stresses such advantages as silent operation, fuel flexibility, speed, easy maintenance. Cleaver-Brooks Co.

**131 Gas Burners and Furnaces** — This 34-pp catalog illustrates and describes company's line of burners, furnaces, valves, torches, mixers, blowers, and water warmers. Features furnaces and burners for specific purposes. Presents a line of temperature regulating and safety control equipment and gives full specifications for every model. Chart showing capacities is included. Johnson Gas Appliance Co.

**132 Circular Arches for Furnaces** — Bulletin 554 describes sectionally supported roof arches for circular furnaces and presents detailed information on construction. Diagrams and photos illustrate principle which enables concentric rings of steel tubes to be suspended from steel beams. George P. Reintjes Co.

## COAL HANDLING

**135 Coal Crusher** — Company's WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

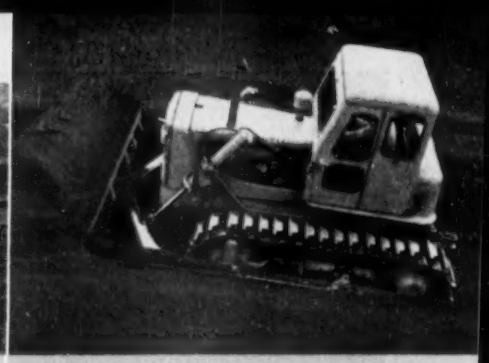
**136 Pneumatic Handling System** — Of value to power engineers concerned with the handling of dry pulverized materials, 16-pp Bulletin G-2 tells how handling costs can be reduced by using the proper pneumatic handling system. Lists 86 dry pulverized materials and indicates which of three systems is best suited to handle each material. Discusses company's system for conveying such materials as Portland cement, pulverized coal, limestone dust, fly ash, pulverized rock. Fuller Co.

**137 Jet Pulverizers** — Bulletin 541 gives wide application range of company's low cost, high efficiency jet pulverizer. Explains details of operation, illustrating various zones of operation. Stresses value of pulverizer in combustion applications. Majac, Inc.

**138 Concrete Storage Bins** — This 29-pp brochure on concrete stave storage bins contains table of cubic foot weights of flowable materials; bin capacities per foot of height; description of wall construction; information on super-concrete stave test

**Stockpiles coal anywhere —**
Coal brought in by water to Midwest chemical plant is economically hauled to stockpile, spread in 4-in. layers and compacted by Allis-Chalmers 41,000-lb., 175-net engine hp. HD-20 Tractor pulling scraper that carries 18 tons.

**Stockpiles, compacts, loads —**
Allis-Chalmers 40-drawbar HD-5G Tractor Shovel pushes coal onto stockpile, then with its 16,200 lb. plus added weight of loaded bucket compacts it, and finally with 2-yd. (1½-ton) bucket loads coal from stockpile to trucks for hauling to plant as needed.



**Handles coke for steel mill —**
Allis-Chalmers 72-drawbar hp., 18,800-lb. HD-9 Tractor dozes coke out onto stockpile, levels and compacts it, then reclaims it as needed. Freezing of coke surface in winter no longer hinders operation with tractors as it did with previous system.

**Takes care of all coal handling . . .**
This 109-drawbar hp., 27,850-lb. Allis-Chalmers HD-15 Tractor easily stores and reclaims all coal for an Eastern power plant.

# Tractors Make Coal Handling More Flexible

Storing and reclaiming coal with tractors is considerably more flexible, as well as more economical, than with complex conveyor or crane systems. Tractor handling permits keeping equipment investment in close balance with current operating needs at all times. As demand increases, or if it is necessary to speed up handling during rush periods, more tractor units can be added. Also, storage areas can be abandoned without leaving money tied up in idle stationary equipment.

With tractors, coal can be stored wherever there is available space — and can be reclaimed whenever needed. Crawler tractors work free of rails and runways, make their own "roadway" anywhere. They can handle all coal moving — or will supplement existing facilities.

## Work with Blades, Scrapers, Front-End Shovels

When unloading station is near storage area, tractors with bulldozer blades can economically move coal alone or work along with other equipment. Teamed up with scrapers, the tractors can haul coal to remote storage areas located anywhere. Tractor shovels are versatile units that can move coal to stockpiles and reclaim it, maintain piles, or load it to hoppers, cars or trucks.

Whether they work with blades, scrapers or front-end shovels, tractors spread coal out in thin layers and compact it well by constant travel over the pile. This tight packing of horizontal layers eliminates flues that cause spontaneous combustion in loose conical piles.

## Handle Other Jobs, Too

Tractors offer additional versatility and flexibility through other than coal handling use. They also can take care of plant or yard maintenance, car spotting, snow removal, excavating, moving heavy equipment or materials, dozens of other jobs.

Find out more about how tractor equipment can improve coal handling for you. See your Allis-Chalmers industrial tractor dealer for a demonstration. Also, send for free booklet, "Economic Coal Storage with Allis-Chalmers Tractors."

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data; detail drawings of stave, rods, and lugs; specifications and drawings of concrete roof; other material provided deals with foundation curb on common roof of adjacent bins for supporting superstructures; photos of access openings; elevated floor and overflow partition; openings; boiler-house coal bins. Available to qualified power engineers; please state your title. The Neff & Fry Co.

### FANS, BLOWERS

**139 Quiet Operating Fan** — Bulletin CTB-103, 12-pp, covers in detail company's Turbo-Pressure blowers, designed to furnish air at high pressures for use with oil and gas burners on industrial furnaces for pneumatic systems, and other applications. Well-illustrated, contains necessary charts and specifications for this type of fan. Chicago Blower Corp.

**140 Centrifugal Blowers, Exhausters** — Twelve-pp Bulletin M-103 describes company's blowers and exhausters for applications requiring air pressure from 1 to 9 psi, or vacuum from 2 to 12 in. of mercury. Discusses design, types and advantages of the models and contains several charts showing the capacity ranges of both blowers and exhausters. Air Appliance Div. U. S. Hoffman Machinery Corp.

### PACKING

**141 Packing and Gaskets** — This 6-pp folder gives information on packings and gaskets of Chempac materials which are made of asbestos treated with Teflon. Describes several types: interlocked packings; coil, spiral and ring packings; general purpose gasket; folded gaskets for glass lined equipment; and gaskets for high pressure service. Johns-Manville.

**142 Packings for Chemicals** — Dura Plastic Teflon packing for sealing applications in the handling of corrosive chemicals is introduced in Bulletin 461 M.D. Stresses heat resistance of the material, chemical inertness. Discusses construction details and lists number of packings for use with specific chemicals, such as for acids, ammonia. Durametallic Corp.

### WATER TREATING

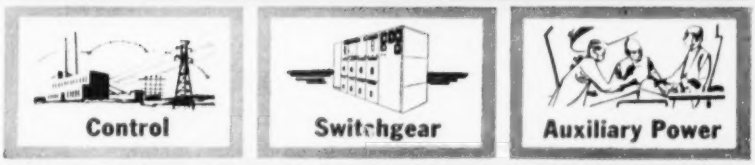
**143 Basic Anion Resin** — Duolite Data Leaflet 31, 16 pp, describes in detail the nature and operating characteristics of Duolite A-41, a difunctional, strongly basic anion exchange resin — used for producing electrolytically pure water, free of all but trace quantities of silica and carbon dioxide. Text covers properties and advantages of Duolite A-41, performance characteristics, regeneration. Booklet includes chart of more than 30 ion exchanges and absorbent resins. Chemical Process Co.

**144 Testing Equipment** — Designed for use as a guide in the selection of water testing equipment, this 12-pp bulletin describes complete line of titration stands and test sets for hardness, alkalinity, chloride, sulfide, etc.; cabinets and test sets for similar tests; Conducto bridge for determination of specific conductance of water solutions. W. H. & L. D. Betz.

### METALS

**145 Cast Stainless Alloys** — A series of 13 individual data sheets covering properties of popular grades of alloys used for corrosion resistant (stainless steel) castings

NOW-2 C&D batteries for




Now you can have your choice of *two* modern C&D batteries—specifically designed for control, switchgear, and auxiliary power applications. The two batteries, PlastiCal and PlastiCell, are available in practically any capacity—from 10 A.H. to 770 A.H.

PlastiCal has lead-calcium grids for maximum life—conservatively engineered for 25 years in full-float service.

PlastiCell has positive plates made of high-tensile alloy grid metal for extra life and has a projected life of 14 years in float service. With both PlastiCal and PlastiCell you get:

1. **Extra-long life. Exclusive design combines advantages of both suspended and supported plate construction.**
2. **Triple insulation—thick Fiberglas mat, microporous separators, and perforated Koroseal retainer.**
3. **Saftee Vent—outstanding C&D development that prevents accidental battery explosions.**
4. **Crystal-clear plastic jars—heat-resistant and hermetically sealed.**
5. **Plastite Post Seals—easier maintenance.**

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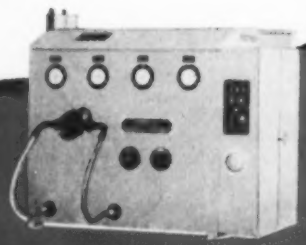
for dependable, efficient combustion

the PEABODY PK-54 AUTOMATIC BURNER



Since its first appearance, the Peabody PK-54 Automatic Burner has been an unqualified success. Firing oil, gas, or both—with unit capacity to 42,000 lbs. of steam per hour, this compact, complete burner is now the first choice for either factory-assembled boilers or conversion installations. Low noise level, complete accessibility, "built-in" forced draft fan, combustion and safety controls, are only a few features that assure peak performance. For complete details, write for Bulletin 430.

PEABODY ENGINEERING CORPORATION
160 FIFTH AVENUE, NEW YORK 10, N. Y.

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is featured in this 26-pp booklet. Information was collected from many sources in cooperation with such groups as the ASTM and SAE. Each data sheet lists chemical compositions, physical and mechanical properties, and includes a discussion of design considerations. Alloys are described with respect to metallurgical structure and characteristics, and preferred heat treatments. Alloy Casting Institute.

**146 Nickel Alloy Steel** — Bulletin A-68, 36-pp, includes more than 70 mechanical property charts showing tensile and impact properties which may be regularly expected in the quenched and tempered nickel steels in different sizes. General characteristics of each type are briefly described as an aid in the selection of steels. The International Nickel Co., Inc.

**147 Design Sheets on Aluminum** — Now available to power engineers is "Designing with Aluminum," a set of seven design sheets in attractive file folder. They cover thermal conductivity and reflectivity; electrical characteristics; corrosion resistance; strength; thermal treatments; other subjects. One sheet is devoted to use of aluminum for ducts. Kaiser Aluminum & Chemical Sales, Inc.

**It's easy to get these free catalogs—just circle item numbers of those wanted on the two post cards provided on pages 117-118**

**148 Ductile Iron** — "Effect of Chemistry and Section Size on Properties of Ductile Iron," is title of 12-pp Bulletin DI-16. Discusses influence of carbon, silicon, and phosphorous contents and of section size on the mechanical properties of ductile iron, a family of irons which possesses process advantages of cast iron and properties comparable to those of cast steel. The International Nickel Co., Inc.

**149 Industrial Products Catalog** — This 48-pp catalog illustrates representative parts produced by eleven divisions of company and details physical properties or characteristics. Breakdown is by type of product, and catalog contains sections on ferrous castings, non-ferrous castings, bearing materials, sintered metals, steel forgings, welded products, air compressors, industrial pumps, dredge pumps. American Brake Shoe Co.

## MECHANICAL POWER TRANSMISSION

**150 High Capacity Gearing** — A quick picture of design improvement opportunities offered gear users through the size, capacity and cost advantages offered by manufacturer's Duti-Rated Lifetime gearing is presented in 8-pp Bulletin DRB, 15 M 554. Dramatizes advantages with comparative photos of a heavy-duty transmission before and after application of this gearing. Illustrates other applications. Foote Bros. Gear and Machine Corp.

**151 Improved Transmission Belt** — Brochure 6638, 8-pp, describes company's Poly-V drive. Design characteristics of the single, endless belt with molded lengthwise ribs, are explained in line-drawings that show 14 advantages of the drive. Brochure uses V-belts and sheaves as a

# GIVES YOU ANY RPM— AND ONLY 14¼" HIGH!

## FRACTIONAL HORSEPOWER

## VARIABLE SPEEDS—IN SMALLEST PACKAGE

HERE'S the new variable speed motor that cost-conscious plant operators have long sought. It's the light weight U. S. Varidrive, Type VA, compactly dimensioned to occupy least space, yet suitable for rugged industrial duty just like the larger HP Varidrive line. Compact dimensions and light weight now make built-in application of variable speeds practical. You can mount it right on your machine, close in; or in any position on floor, wall or ceiling, with or without remote control.

### Quick, Accurate Dial Control

Full speed range instantly obtained in less than one turn of dial handle. The stationary dial plate is precisely calibrated for close speed setting, yet easily visible from a distance.

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You can greatly increase the performance and output of your machine using fractional horsepower with Type VA. You can now get the exact speeds needed for each operation. Your operator can control the speed to a split rpm to accomplish better workmanship and to actually gain more output. This amazing motor invariably repays its low-cost investment within a few weeks.

**14¼" High x 8½" Wide**
**Weight—87 Lbs.**
**Easiest Dial Control**
**Single and 3-Phase**

# U.S. VARIDRIVE MOTOR

### Bulletin Chock-full of Facts

You'll want to study the internal workings of this revolutionary small horsepower motor—see how it works, note the high excellence of materials and the advanced engineering skill that makes Type VA the wonder motor. All the facts are interestingly presented in Bulletin No. 1797. Engineering details and many types shown.

**U. S. ELECTRICAL MOTORS INC.**
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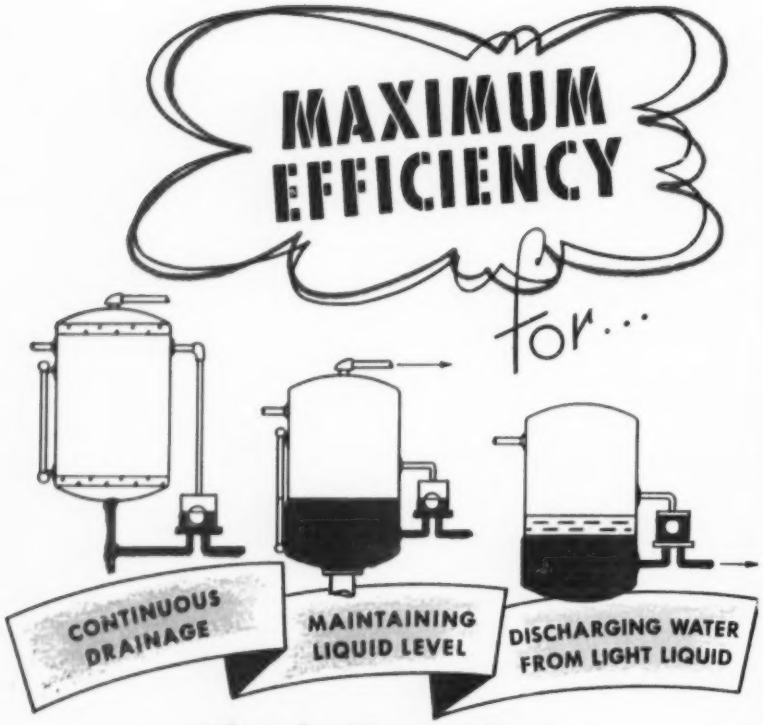
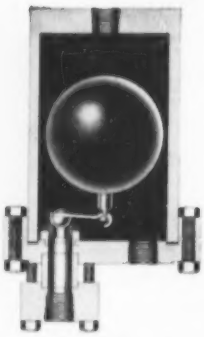



# Clark Duo-Step FLOAT TRAPS



• Fabricated steel float trap

## Clark Float Trap Series 450-D

As indicated above, the Clark 450-D Float Trap is designed to maintain 3-way control over liquids in transit or storage.

The illustrations show how the Float Trap is used for different applications.

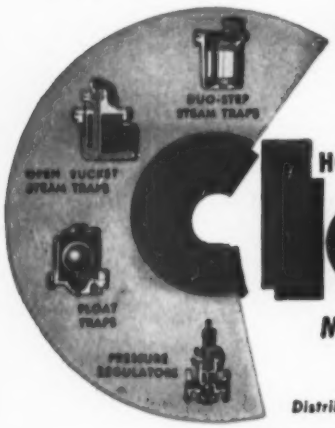
Clark is the *only* Float Trap that offers the Duo-Step feature—two fulcrum points for maximum power and valve travel without increasing the physical size of the trap.

The Duo-Step 450-D is only one of many traps and valves manufactured by Clark for every control and drainage purpose. See your Clark representative or distributor . . . or write us direct for the complete story.

CLARK AIR TRAP No. 440

CLARK VENTING TRAP No. 244 V

CLARK "Y" STRAINER

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standard for comparison of Poly-V with conventional drive. Text and line drawings explain why drive gives more contact area, and more horsepower, offers other advantages. Manhattan Rubber Div., Raybestos-Manhattan, Inc.

**152 Shaft Mounted Drives** — Power engineers who use machines requiring input speeds between 420 and 10 rpm in the range between ½ and 30 hp, will be interested in 8-pp Bulletin 7101. Contains complete information — design data, selection tables, dimensions, weights, installation photos — on this modern type of standard gear drive for high ratios of speed reduction in limited space. The Falk Corp.

### OTHER EQUIPMENT

**153 Industrial Equipment** — Catalog 950 is a 340-pp ordering guide on this manufacturer's standard products, including chains and sprockets for conveying, elevating and power transmission. Tables of pre-engineered drives aid in selection of standard roller chain drives and silent chain drives. Complete listings are given of stock and made-to-order chains and sprockets. A section on conveyor components lists products for screw conveyors, belt conveyors, oscillating conveyors and bucket types. Capacity charts and dimension tables included. Available to qualified power engineers, please state your job title when requesting this book. Link-Belt Co.

**154 Welding, Cutting Equipment** — General Products Catalog ADC 6662B, 52 pp, covers Airco gases, welding and cutting equipment and accessories — torches, tips, regulators, electrodes. Also includes such recent developments as Aircospot inert-gas spotwelding. Catalog explains how each item operates and the jobs to which it is best suited. Complete specifications and stock number information is supplied. Air Reduction Sales Co.

**155 Industrial Cooling Tower** — Publication CT-HD-0.002, 36-pp, describes induced-draft cooling tower construction and applications. Profusely illustrated with photos, sketches, cutaway and exploded drawings showing the detail of structural and mechanical equipment, this bulletin will be of particular interest to power engineers concerned with heat dissipation. Advantages of company's Counterflo design, methods of water distribution are covered in detail. The Fluor Corp.

**156 Organized Training Programs** — Industrial training problems are discussed in "The Training Job and How to Meet It." The 24-pp illustrated booklet traces the correspondence approach to industrial training and appraises the various ways that correspondence education can be adapted to meet training problems on either an individual or group basis. Outlines of typical courses are included. International Correspondence Schools.

**157 Gas Turbines** — Twelve-pp Booklet GEA-5962 contains detailed information on the operation and application of gas turbines for gas pipelines. Tells how gas turbines lower costs, improve efficiency. Numerous drawings and illustrations explain turbine uses. Points out that simplicity of operation adds to turbine life, cuts maintenance, and assures continuous heavy-duty service. Presents plans for installation and emphasizes turbine's small size which makes it suitable for use in a limited area. General Electric.

*continued on page 131*

*" You see Powell Valves everywhere! And with . . .*

. . . good reason! They're famous for dependability. Economical, too.
What's more, Powell has a complete line. "

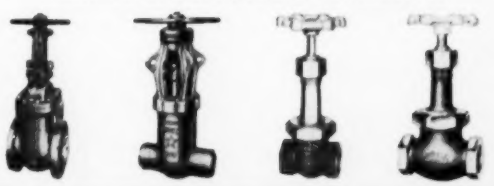
## Famous for dependability

**SINCE 1846**

Wherever flow requires dependable control, there's *the* place for Powell Valves. Powell probably makes more kinds of valves and has solved more valve problems than any other organization in the world.

Available through distributors in principal cities. Made ⅛" to 30" and for 125 pounds to 2500 pounds W.S.P. Bronze, iron, steel and corrosion-resistant metals and alloys. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

**CONTROLS FOR THE LIFE LINES OF INDUSTRY**



# Powell Valves

*108th year*

**For more data circle 522 on Post Card**

custom built systems
HAGAN
automatic
combustion controls
HAGAN
ring balance
instruments
For thirty-five years the leaders in advancing steam production efficiency with Automatic Combustion Control and Instrumentation Systems.
HAGAN
HALL
BUROMIN
CALGON

# from standard components

*Custom Built from standard components* sounds like a contradiction. But it is a fact that each Hagan unit is designed, not only to perform its specific functions efficiently, but also to operate smoothly in combination with other Hagan components. Thus, every Hagan System of Automatic Combustion Control and Instrumentation can be custom built to maintain the exact operating conditions which result in optimum steam production efficiency.

Thirty-five years of experience with all types of boilers, and with every combination of temperature, pressure and fuel system requirements, goes into the design of every Hagan unit and system. As a result, a Hagan System is thoroughly coordinated and easy to calibrate. Adjustments are ample in number and range, so that our engineers—or yours—can get the entire system into accurate operation with a minimum loss of time.

Many of our customers have standardized on Hagan Controls and Instruments for improving existing facilities and for extensions and new construction.

Make Hagan Automatic Combustion Control and Instrumentation the choice for your next installation!

## HAGAN CORPORATION

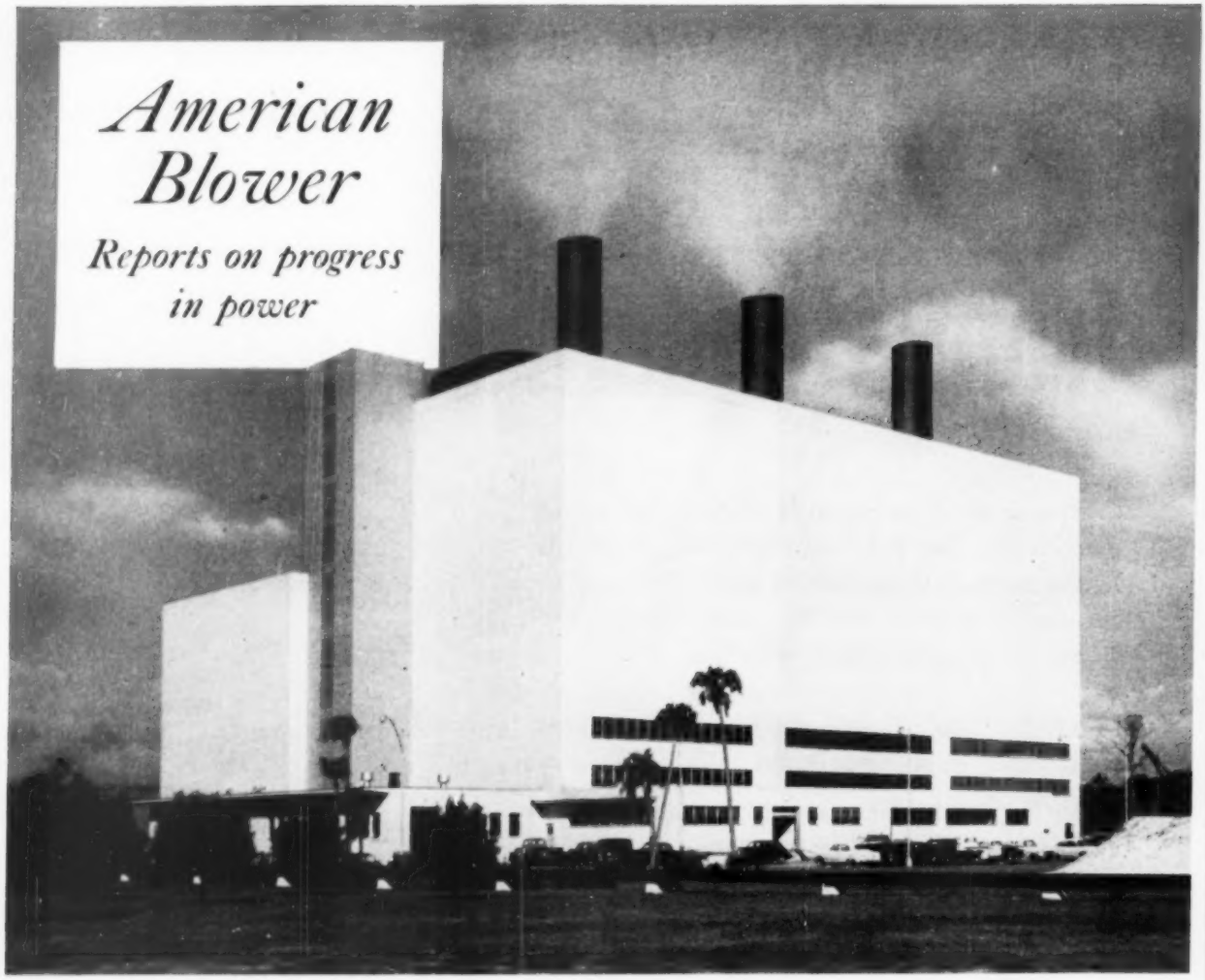
**HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA**

**Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems • Control Systems for Automotive and Aeronautical Testing Facilities**

**For more data circle 523 on Post Card**

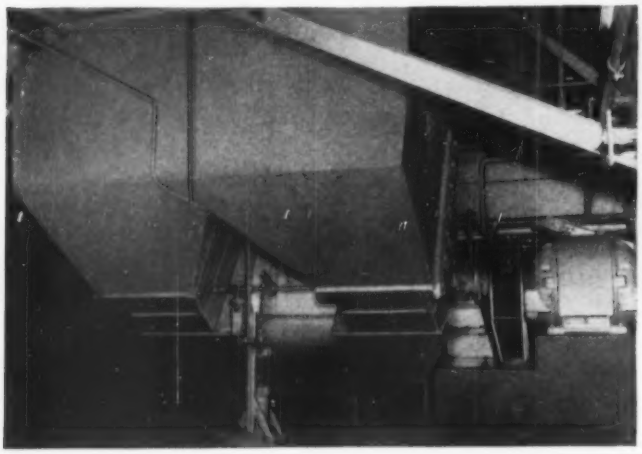
# *American Blower*

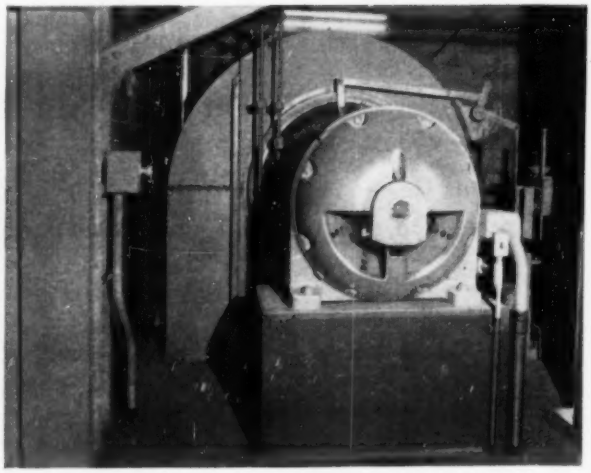
*Reports on progress in power*



Completed in 1954, the Higgins Plant at Oldsmar, Florida has a capability of 135,000 kw. Each of its three steam generating units requires 550,000 barrels of fuel oil annually.

Florida Power showed a remarkable increase (279%) in electric sales revenues from 1942 through 1952. Continued expansion is anticipated to meet the growing demand. Shown below is one of the new American Blower Induced Draft Fans on #1 boiler at the beautiful new Higgins Plant.



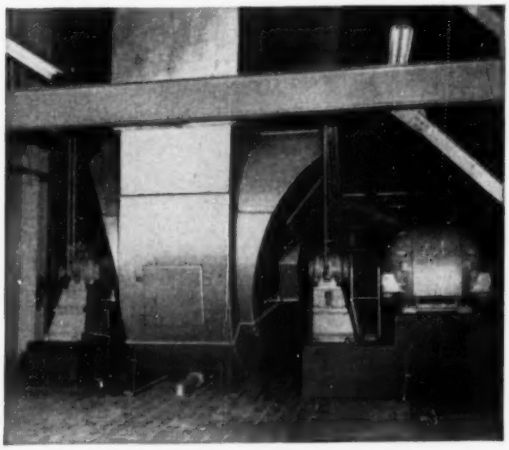


Also on Higgins #1 boiler is this American Blower Forced Draft Fan, rated at 81,400 cfm, 695 rpm, and 10.5" sp. Florida Power helps make the communities it serves good places to live and work.

***Serving home and industry:*** **AMERICAN STANDARD** •

# Florida Power Corporation keeps pace with rising needs for electricity

*In 1897,* the first plant of what is now the Florida Power Corporation went into operation with a wood-burning boiler and a 50 kw generator. Today, Florida Power and its subsidiary, Georgia Power and Light Company, serve 31 counties in Florida and 21 counties in Georgia. Total capacity is now 408,300 kw!



Here's another American Blower Sirocco Induced Draft Fan at the Higgins Plant. It is rated at 145,400 cfm, 695 rpm and 10.9" sp. Throughout the power plant industry, American Blower's experience and know-how are helping plant operators solve their power plant problems.

Naturally, this continued expansion has been based on the growing needs of the area for low-cost electricity for homes, business and industry. Future needs are anticipated and planned for . . . years ahead of time.

Like other investor-owned utilities, Florida Power keeps output high and costs low by selecting dependable, efficient equipment — including American Blower Forced and Induced Draft Fans.

Power plant operators everywhere are specifying American Blower Mechanical Draft Fans, Dust Collecting Equipment, Fly Ash Precipitators and Gyrol Fluid Drive for boiler feed pump and fan control. They know they can depend on American Blower Equipment and American Blower technical assistance.

If you have an air handling problem, or are planning to expand or modernize, find out how American Blower can help you. Contact your nearest American Blower Branch Office, or write us direct.

**AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN**
**CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO**
Division of American Radiator & Standard Sanitary Corporation

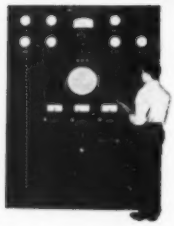
**AMERICAN BLOWER**

**AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS**

**For more data circle 524 on Post Card**

# for the man considering a PACKAGE BOILER

## new all-electric METERING TYPE PACKAGED CONTROL by HAYS



Now available for *all* makes and sizes of water tube type package boilers is the new all-electric, metering type Hays packaged control.

**Metering type control** provides maximum combustion efficiency regardless of the fuel burned because it *actually meters* the fuel flow and air flow, and automatically maintains the desired ratio. No adjustments are needed when changing fuels or oil burner tips.

**All-electric operation** includes not only safety devices but also steam, fuel, and air controllers and valves—uses only the normal source of AC voltage. No compressed air is required.

**Fully automatic, safe** and reliable operation is assured because Hays maintains the same industrial quality built into the largest utility combustion control system and it is factory tested before shipment.

**Complete package** in one simple and inexpensive to install panel board.

*Write today for fact-filled Bulletin* 53-1088-239.

Automatic Combustion Control
Boiler Panels • $CO_2$ Recorders
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

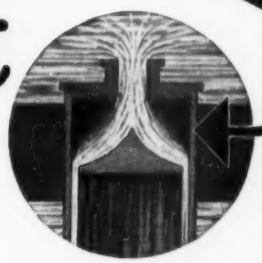
THE hays CORPORATION

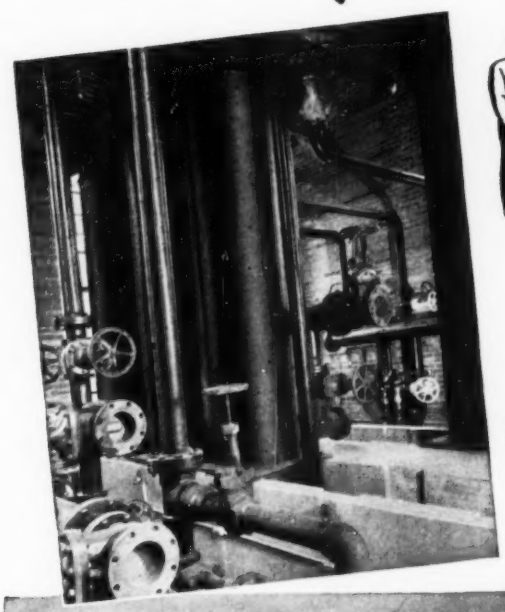
MICHIGAN CITY 7, INDIANA

For more data circle 525 on Post Card

# Dirty Water can't "Shut-down"...

# Vogt

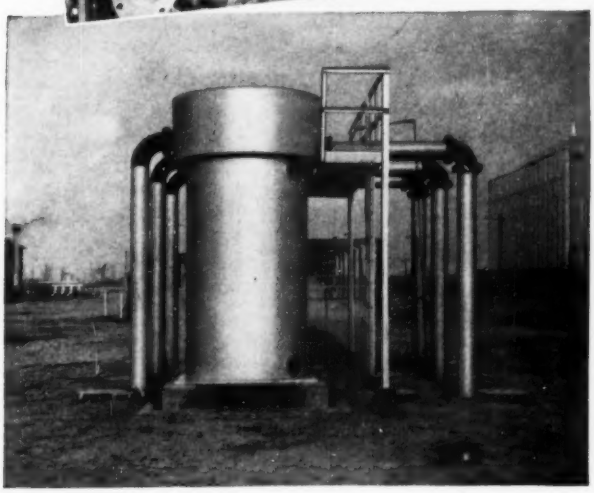




# film type exchangers

## (Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

**TOP:** *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

**BOTTOM:** *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[ Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request. ]

## HENRY VOGT MACHINE CO., LOUISVILLE, KY.

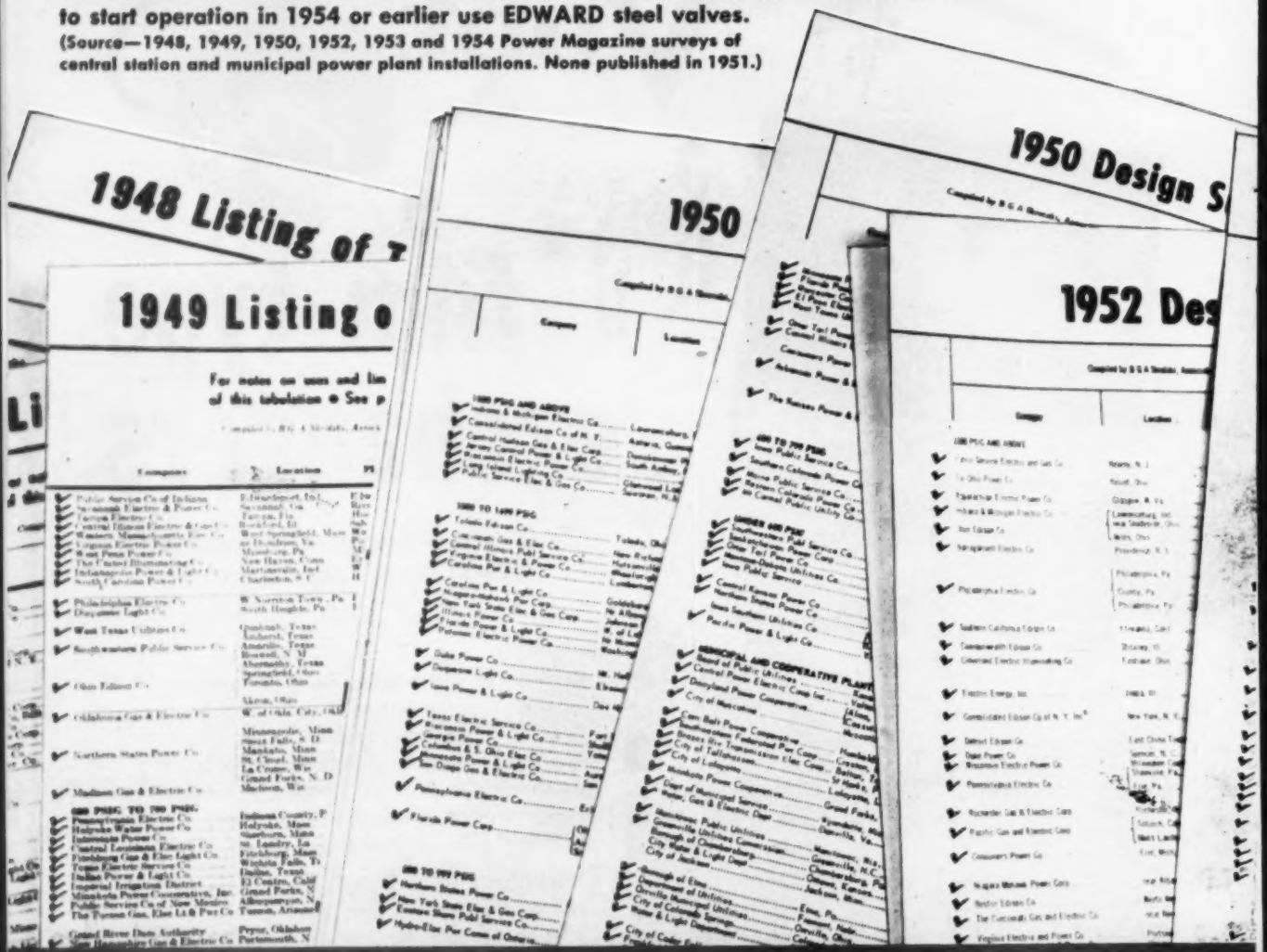
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

For more data circle 526 on Post Card

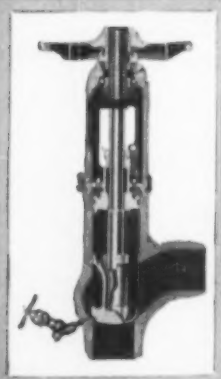
# Again in '54 it's Edward Valves

**THE EVIDENCE:** **674 out of 699 (96.42%) of new central station and municipal power plant projects scheduled to start operation in 1954 or earlier use EDWARD steel valves.**

**(Source—1948, 1949, 1950, 1952, 1953 and 1954 Power Magazine surveys of central station and municipal power plant installations. None published in 1951.)**

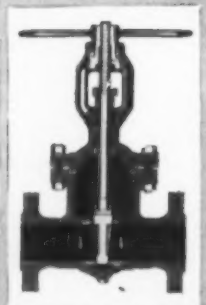



## TYPICAL EDWARD DESIGNS GOING INTO NEW STATIONS



Cast Steel Non-Return

Cast Steel Stop

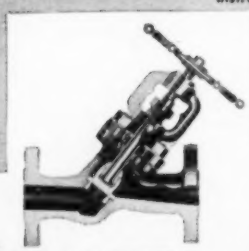


Cast Steel Gate

Cast Steel Check

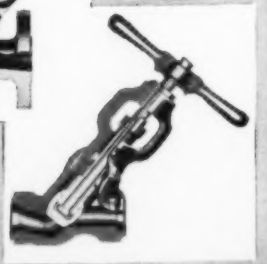
Forged Gage

Forged Stop



Blow-off

Forged Instrument

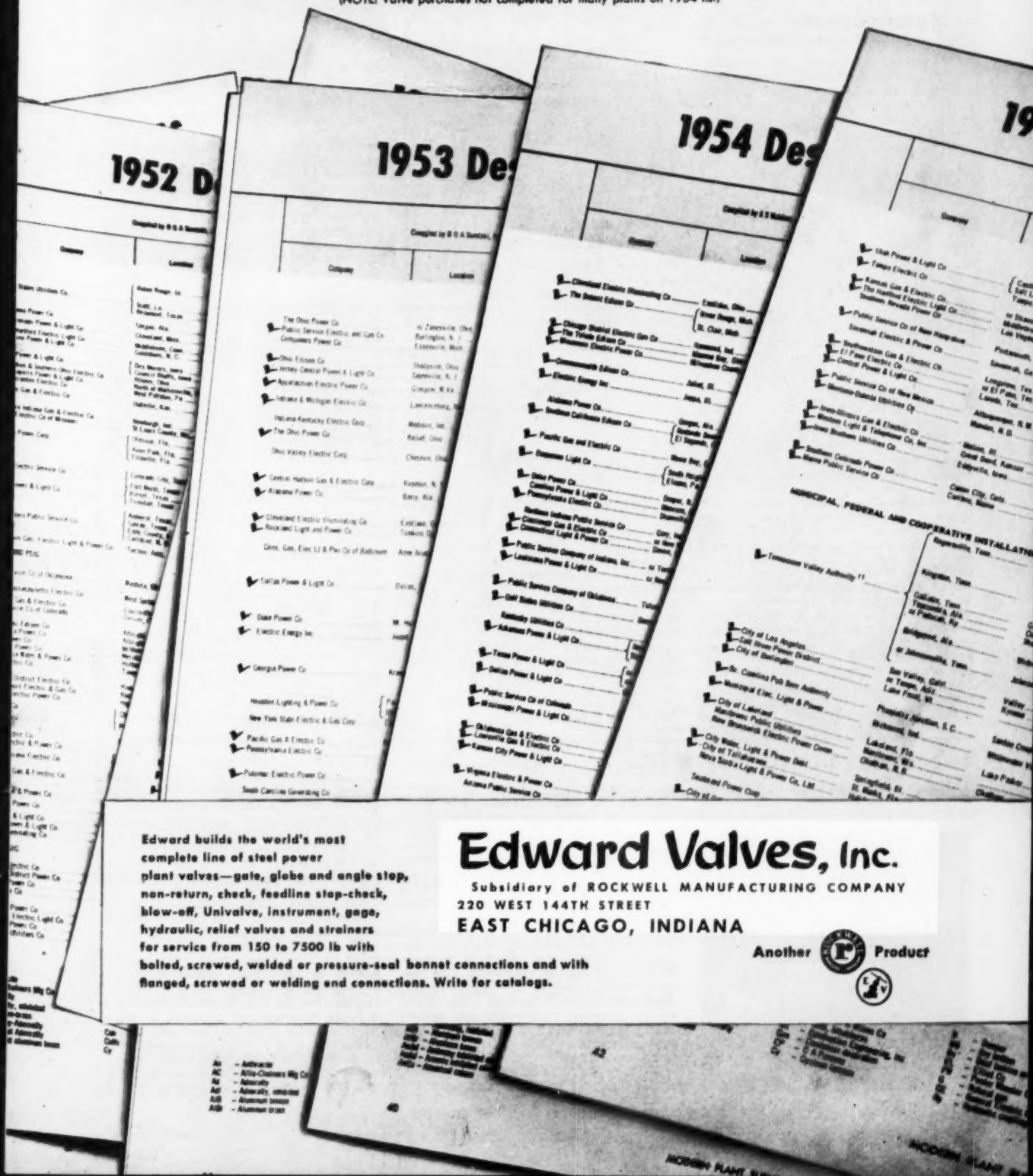


Forged Univalves

# in over 96% of new power plants

✓ Indicates identified purchases of Edward valves for specific generating capacity additions. In the 1954 survey, records show Edward valves in 39 out of 40 new plant additions scheduled to start operation 1954 or earlier, a 97.5% acceptance.

(NOTE: Valve purchases not completed for many plants on 1954 list)




**Edward builds the world's most complete line of steel power plant valves—gate, globe and angle stop, non-return, check, feedline stop-check, blow-off, Univalve, instrument, gage, hydraulic, relief valves and strainers for service from 150 to 7500 lb with bolted, screwed, welded or pressure-seal bonnet connections and with flanged, screwed or welding end connections. Write for catalogs.**

## Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
220 WEST 144TH STREET
EAST CHICAGO, INDIANA

Another Product

# EQUIPMENT NEWS

Described on these pages are new and improved products. Use Reader Service Cards on pages 117–118 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

### 1—CLUTCH-COUPLING UNIT is full-complement type

For applications where over-running features are required in conjunction with a flexible coupling, a new full complement clutch coupling is introduced. It is being applied most often in dual drive and alternate power applications. To compensate for the large range of operating conditions encountered, this unit incorporates, within the same space limitations, two types of construction. One is specifically designed to be used for low speed over-running applications, and the other, where practically continuous high-speed over-running conditions are encountered.

It is explained that through this full complement construction, energized sprags grip at an infinite number of positions, and the unit has the following performance characteristics: instantaneous operation with no backlash; maximum capacity for its size and weight; and long service. Formsprag Co.

### 2—BRACKET BOXES offer maximum conductor capacity

According to manufacturer, eight No. 12 wires can be used in these 4 in. sq bracket boxes, which are furnished with BX clamps for armored cable or RX clamps for non-metallic sheathed cable. Both types of clamps are said to be strongly constructed and feature a nested fit for quick, easy pulling of wires. A bracket is welded to side of box for mounting on stud faces. Both boxes and brackets are heavy gage sheet steel; and adequate nail holes are provided on bracket, along with two lanced spikes, for faster installation. Knockouts for $\frac{1}{2}$ in. cable are stamped in box, two on side opposite bracket and one on the bottom. Although the knockouts are securely attached to box, the use of specially designed knockout dies is said to make their removal quick. Keystone Mfg. Co.

### 4—PH CONTROLLER is electronic indicating instrument

Featuring a high-torque, jeweled, millivoltmeter-type movement, this electronic pH controller is available with several electric control actions. They include two-position; two-position with normal zone; two-position with proportional-imput; and three-position control. It is designed to actuate a wide variety of final control devices, permitting pH control with liquid, gaseous, or solid reagents. The controller has a 7-in. mirror scale for easy reading, is housed in a case designed to keep out dust and vapor. Specifications are provided in Bulletin Q1304. The Bristol Co.

### 5—WATER SOFTENER with manual or automatic control

These zeolite water softeners are announced as individually designed units meeting particular size and capacity requirements for soft water in food processing plants, power plants, railroad locomotives, textile plants, and in potable soft water supply. Company offers choice of controls for either manual or automatic operation. Standard equipment is a multiport single control valve but a nest of individual valves can be furnished if desired. The Industrial Filter & Pump Mfg. Co.

### 3—PORTABLE INCINERATOR handles all average dry waste

Although the basic design of this portable incinerator is suited to incineration of dry waste, manufacturer says modifications are readily made for disposal of pathological waste, garbage, and other wet refuse. Capacity of the three standard sizes ranges from 200 to 450 lb per hour. A feature of the new model is an extra large door that simplifies charging bulky objects such as large boxes and cartons. The door is of the split-guillotine type, counterbalanced to afford effortless operation.

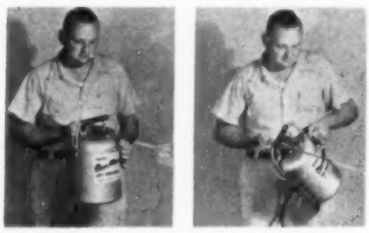
Another significant feature announced is the long gas travel provided, with numerous velocity and direction changes for high combustion efficiency. The unit also has a separate settling chamber, permanent steel skids, and a top stack outlet designed to shorten the overall stack length required. The stack, an optional item, is self-supporting. The incinerator has a steel casing, monolithic refractory lining. Full data on the unit is provided in Form 65. Plibrico Co.

### 6—CHLORINE GAS FEEDER is visible flow model

The Model EVS Chlorinizer is announced as a visible flow chlorine gas feeder designed to combine accuracy, dependability and safety with low cost. It is available in capacities of 4 to 400 lb per 24 hours with a metering range of 8 to 1. Accuracy is given as within ±4 per cent. The feeder stands 66 in. high, 17 in. wide and 12 in. deep. It has a panel with recessed, eye-level indicator, flush mounted gages for chlorine and injector supply pressures, and adjustment knobs for chlorine feed rate and tray water flow. Builders-Providence, Inc.

### 7—STEAM JET CLEANER is portable and easily operated

Rapid cleaning of motors, compressors, condensers, machinery and engines — without dismantling — is claimed possible with the Model 111 Steam Kleen Jet Sprayer. In this cleaner, the steam jet feed is operated by finger tip control. Changeover from wet to dry steam is instantaneous, says manufacturer, and accomplished by merely tilting the unit from the horizontal wet-steam position,



shown at right, to vertical dry-steam position. The unit is designed to degrease as it cleans and can be used on small parts, too.

Light in weight, the Model 111 weighs about 16 lb ready for operation. It has a capacity of $\frac{1}{2}$ gal of water and can be brought up to operating temperature from cold water in 20 min. With hot water, the waiting period is shortened. Company says normal degreasing time is approximately 20 min. The unit is electrically heated, thermostatically controlled, and operates on 110- and 115-v circuits. Henry Flow Control Co.

### 8—STATIONARY BATTERIES for control switchgear

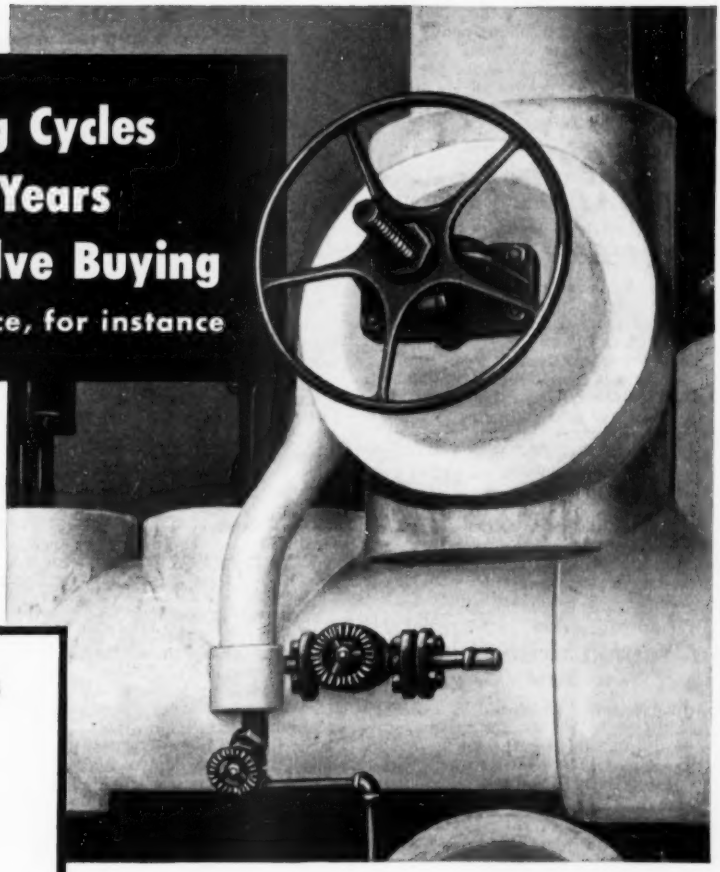
These batteries are specifically designed for switchgear, control, and auxiliary power applications, says manufacturer and are not of a compromised construction to cover all types of stationary service. They are made in two lines, PlastiCell and PlastiCal, in capacities from 10 to 770 amp-hr. The former is intended for full-float operation where a life-expectancy of 14 yr in float service normally applies. Proportionately long life is also anticipated when used in trickle charge service.

The PlastiCal features lead calcium grids (in sizes from 40 to 770 amp-hr) and is said to offer a conservative life expectancy of 25 yr in full-float service. It is pointed out that this battery further reduces maintenance required because water additions are required less often.

Both lines of the batteries have extra thick positive plates with triple insulation suspended from ledges molded into the jar, to allow normal plate growth

# 1248 Operating Cycles Through 24 Years Prove Quality Valve Buying

. . . for main steam service, for instance



## The Installation

At the Champion-International Paper Mill, Lawrence, Mass., featuring Crane 400-pound steel gate valve in main steam line to turbine. Working pressure: 400 psi at 600 deg. F.

## Valve Service Ratings

**SUITABILITY:** Never a question

**FEATURES:** Quality throughout

**MAINTENANCE COST:** Not a cent

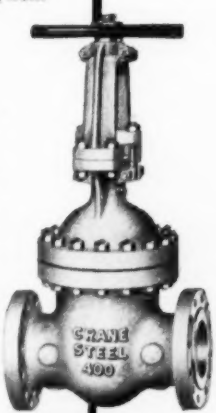
**SERVICE LIFE:** 24 yr.—still in line

**OPERATING RESULT:** Lower power costs

**AVAILABILITY:** Regular Crane Catalog item

## The Valve

Improved constantly through the years, Crane steel valves for elevated pressures and temperatures are known and respected everywhere for outstanding, low-cost performance. They're made in the widest range of body and trim materials—in all pressure classes and sizes—with screwed, flanged, or welding ends. See your Crane Catalog, or consult your Crane Representative.




## The Case History

Installed in 1930, this Crane valve has been in continuous use ever since. In 24 years the valve has not required service or maintenance of any kind.

More significant is the quality of performance of this 8-in. steel gate valve. Operated for week-end shutdown of the turbine, it has never failed to respond to the handwheel with smooth, steady action. Both seating and stem seal remain as tight as when the valve was first installed.

Performance like this begins in just one way—by making quality the first consideration when buying valves. Today, such a buying policy is sounder than ever and Crane quality, more than ever, helps assure the best results at lowest ultimate cost.

*THE BETTER QUALITY . . . BIGGER VALUE LINE . . . IN BRASS, IRON, STEEL*

# CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
*Branches and Wholesalers Serving All Industrial Areas*

***VALVES • FITTINGS • PIPE • PLUMBING • HEATING***

**For more data circle 528 on Post Card**

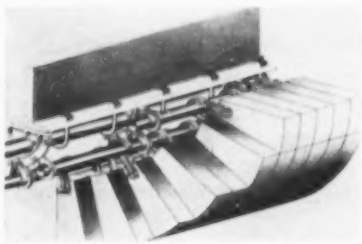
without strain on the cover. Negative plates are supported on heavy ribs molded into the jar bottom. They are supplied in a clear plastic, one-piece jar and case which, because of its lighter weight, affords lower shipping costs. C&D Batteries, Inc.

### 9—SPEED REDUCERS for mounting in vertical position

Vertical Shaft-King Speed Reducers are shaft-mounted units designed for applications where the driven machine shaft is in a vertical position or nearly so, such as on mixers, agitators, and liquid processing machines. These units, available from stock, can be supplied in both 13 to 1 and 20 to 1 ratios for requirements through 42 hp. These new drives feature helical gears cut from alloy-steel forgings. Both ball and tapered roller bearings are used where they best serve their purpose. Also featured is a three-wall, internally-ribbed housing providing permanent gear alignment, an extra large reservoir, as well as a concentric-shaft design. The units can also be supplied with a torque-arm overload release which protects the driven machine, motor and drive, where jam, choke or shock loads may occur. The American Pulley Co.

### 10—FANTAIL NOSING designed refractory tiles expand

In open hearth furnaces fantail nosings are subject to severe conditions, it is pointed out, and one reason for failure of the section is lack of flexibility within the nosing itself. This new type casting



design is announced as providing for expansion of refractory tiles in all directions. It utilizes arcuate castings placed on steel tubes which are suspended from the steel work with U-bolts. These castings are not bolted to the supporting steel but have freedom for movement horizontally. Because of this, erection of the nosing is claimed to be a fast and simple procedure — oversize or undersize tiles being compensated for by simply shifting or sliding the castings on the tubes from which they are suspended. Shearing of castings is eliminated, says company, and mechanical spalling of refractories reduced. Geo. P. Reintjes Co.

### 11—HIGH VOLTAGE STARTER, air-break type in three styles

Air-break starters for 2200–5000 v squirrel-cage, wound-rotor and synchronous motors are built in three styles: 50,000 kva interrupting capacity; with power fuses for systems of 150,000 kva (2300 v) and 250,000 kva (4600 v) availability; and in the Valimotor (volt-ampere-limitor) style in which air-core reactors limit infinite kva to a finite value within the rating of the starter. The Electric Controller & Mfg. Co.

### 12—TEMPERATURE CONTROLLER is compact and low priced

The Series 540 is announced as a remote indicating temperature controller — in the $75 price range — which is accurate within 1 per cent of full scale under most conditions. This compact controller is designed for economical yet accurate temperature control in ovens and processing equipment of all types. It has a temperature operating range of 100 to 700 F and may be flush-mounted or surface mounted.

Principal features of the new unit include: a double-pole, double-throw power relay rated for 15 amp, 115 v integral with the case; an adjustable differential that can be varied between 0.8 and 4 per cent of scale range; temperature setting pointer and bulb temperature pointer which pivot on the same axis and indicate against the same scale face. This last feature makes it possible to compare actual vs set-point temperatures from a considerable distance from the indicator, without having to read

the dial. This also simplifies calibration.

The new controller operates on a liquid-filled bulb and capillary system with response to temperature change transmitted to a bellows assembly and then to the indicating pointer through a simple mechanical linkage. Control temperature is set with an adjusting knob on the front panel. Fenwal Inc.

### 13—PORTABLE MACHINE for cutting holes in masonry

Using a self-sharpening diamond drilling bit the Mechanized Mole is designed to cut holes ½ to 10 in. in diameter through hard aggregate, including steel reinforced building material, to a depth of 18 in. Deeper holes may be drilled by placing an extension shaft on the bit. According to manufacturer, it takes less than 2 min to drill a 6-in. diam hole in 1 ft of concrete with this machine. It comes in 1-hp and 2-hp models, weighs about 275 lb. The 1-hp size costs about $385. Molco Drilling Machines Corp.

### 14—PIPE STRAINERS in eight sizes, for pressures to 250 lb

Features designed to minimize maintenance are incorporated in this line of cast semi-steel Y type pipe strainers. They are intended for use in steam, air, water, oil and gas lines at pressures to 250 lb. There are eight sizes from ¼ through 2 in. Straight bushing threads, instead of

pipe threads, ease removal for bushing and screen, it is pointed out; and a copper-asbestos gasket is positioned between base of bushing and the body to avoid possibility of gasket blowout. Only a light torque is required for a leak-tight seal, says manufacturer. Type 430 stainless steel corrosion-resistant screens are standard — either perforated 225 holes per sq in., or 20-by-100 mesh wire cloth. Screens of other materials can be furnished. Armstrong Machine Works.

### 15—PLASTIC PIPE is light, tough, and resists corrosion

For handling most corrosives, Dur-Ace is described as a rigid plastic pipe with high impact resistance and toughness. Light in weight, odorless, and non-contaminating, it is resistant to all inorganic acids and alkalis with exception of a few strong acids, it is said, and maintains good strength, rigidity and chemical resistance from −40 to 170 F. Since electrolytic corrosion, bacteria and fungus do not affect it, company recommends it for outdoor applications such as buried water lines, crude oil, gas, brine lines. It is supplied in two wall thicknesses — extra heavy duty with working pressures at 70 F ranging from 300 psi for ½ in. pipe to 150 psi for 2 in. pipe; and standard wall pipe with working pressures for same pipe sizes ranging from 150 psi to 75 psi. Pipe is threaded with standard pipe threading tools or machines, and can be bent in pipe forming equipment when heated. Eight types of pipe, fittings, and tubing are offered, and special custom molded parts, fittings, tubing and extruded parts are available. American Hard Rubber Co.

### 16—METERING INSTRUMENT for use with steam, other gases

The Critiflo-Meter is suggested for plants where steam input to a unit must be accurately controlled and where high accuracy and stability of operation are desired. It can be used for steam and gas measurement and control in refineries and processing plants; for steam proportioning or allocation to individual units or plant departments; and as a prover of other flow measuring devices.

The instrument consists of two parts: a housing containing a chrome carbide or stainless steel nozzle; and a flow indicator connected to the housing. Where desired, a controller or a recording pressure gage, or both, can be used to-

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gether with, or in place of, the dial-type flow indicator. Being simply constructed, this instrument requires little maintenance, company says, and is readily installed in any piping system. Housings come in pipe sizes from 2 to 10 in., for pressures to 900 psi; and rates of flow range up to 300,000 lb per hour of dry and saturated steam.

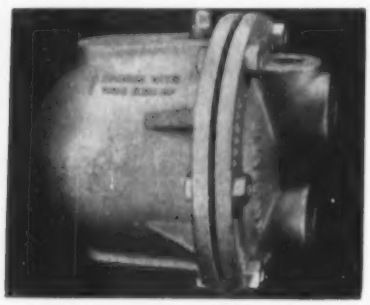
The Critiflo-Meter operates under any condition in which the ratio of absolute pressure upstream (in the housing) is equal to, or less than, the so-called critical pressure ratio for the fluid measured. It is explained that under this condition, the fluid moves through the nozzle throat at sonic velocity — neither more nor less — and variations in downstream pressure have no effect on flow rate, so long as the critical pressure ratio is not exceeded.

According to manufacturer, this principle of operation gives the Critiflo-Meter two special features: (1) Weight flow is directly proportional to upstream or meter housing pressure. (2) Within the range where the pressure ratio is no greater than the critical pressure ratio, fluctuations in the downstream or process pressure cause no change in flow.

This instrument can be used with the flow indicator and a throttling valve upstream, to give a visual measurement of flow and permit manual change of the rate of flow. It can be used with a simple pressure recorder, to permit recording the flow. It can be used as an indicating or recording flow controller, with a pressure-regulating valve upstream from the Critiflo-Meter. It can be incorporated into any complete control system, since its single pressure output is directly proportional to the rate of flow. Bulletin 5011 gives technical data. King Engineering Corp.

## 17—MOISTURE TRAP is low cost and compact unit

Offered to meet the need for a simplified float trap on air, gas and steam applications, the No. 81 Moisture Trap is compact but has good capacities for its size. It is designed as a low cost method of



draining moisture and condensate continuously and automatically from piping systems and equipment which handles air, gas or steam. The trap is suitable for operating pressures to 200 psig and has an optional inlet for ease of installation.

The trap consists of a stainless steel valve and seat, and lever, plus a copper hide float inside a cast semi-steel case. (A stainless steel float can be furnished when specified.) The valve is opened by liquid raising the float and closed when the float drops the liquid level. Either $\frac{1}{2}$- or $\frac{3}{4}$-in. connections can be furnished. With copper float, the trap costs around $17.00. Drawing S-1555 gives details. The V. D. Anderson Co.

## 18—THREADING KIT for pipes and bolts

Announced as lightweight and easy to carry or store, this compact pipe and bolt threading kit provides storage space

for threader and all basic dies. Kit includes hand threader; a set of $\frac{1}{8}$ in. to $\frac{3}{4}$ in. pipe dies; a set of $\frac{1}{4}$ in. to 1 in. bolt dies; and ratchet. Company says the threader is extremely compact — fits palm of hand — and is adjustable for standard and over- or under-standard pipe threads. More than 100 additional dies are available for use with this threader. Beaver Pipe Tools, Inc.

## 19—INSTRUMENT for measurement of earth resistivity

The Model 274 Vibroground is designed to permit exploration of the earth's substrata by electrical resistivity methods to greater depths than heretofore possible with a small, self-contained instrument. According to manufacturer, the new instrument uses the four-electrode a-c fall-of-potential method and reads resistance directly on a large, dial-type potentiometer calibrated to an accuracy of 1 per cent of full scale.

A series of resistance ranges from 0 to 4000 ohms are provided with a new low range of 0 to 0.4 ohms incorporated for maximum depth penetration. Model 274 is self-contained, employing a dry-cell battery operated, vibrator type power supply. Its measuring circuit is basically an a-c bridge. Readings are obtained by balancing a galvanometer type of null detector, and are independent of contact and lead resistance. The instrument is housed in a steel carrying case; it weighs about 20 lb. Bulletin 1-2 gives data. Associated Research, Inc.

## 20—VERTICAL PUMP for high temp, high pressure uses

Two types of vertical, encased, close-coupled pumps — a process type and a transfer type — for handling of hydrocarbons, hot or cold water, mild acids, basic and salt solutions are reported to offer wide application, flexibility, space-saving qualities and excellent NPSH (net positive suction head). In the process type, discharge head and barrel can be provided with 300 psi suction and discharge flanges when higher suction pressure is encountered. Increased wall thickness is designed to add to structural stability of both pump discharge head and pump barrel.

Capacity range of the pumps is given at up to 3000 gpm and head range at up to 1000 ft. Drives can be standard vertical solid shaft electric motors or explosion-proof motors or steam turbine drive as required. Pumps are claimed capable of handling liquid temperatures to 400 F. Peerless Pump Div., Food Machinery and Chemical Corp.

## 21—HEAVY DUTY CLUTCH offers long life, good performance

Extra heavy duty ball bearing overrunning clutches, called the K Series, embody many design features of the Kelpo clutches formerly made by this manufacturer. Typical drive applications for Series K Clutches, which have a toothed inner race driving member that actuates closely spaced independently sprung cams, include dual drives, two-speed drives, centrifugal water pump drives, forced and induced fan drives, and ventilating fan drives in power plants and other heavy industries. Tapped holes are provided in both ends, for attaching sprockets, gears, pulleys or ratchet arms for drive requirements from 1,300 to 6,000 ft-lb. Desired direction of rotation is obtained by attaching component to either side of clutches. Hardened and ground outer and inner races are provided. Tapped holes in end plates act as puller mountings to remove end caps for inspection. Morse Chain Co.

## 22—THREE-PHASE TRANSFORMER has common wound core

The Tri-Wound is available in sizes 9 through 75 kva and in standard primary voltage ratings through 13800 v in the delta, delta wye, or wye-delta connections. The design of this three-phase transformer, incorporates a wound core that is common to all three coils. It offers substantial reduction in weight and height over company's Triplex line which it supplants. Also, many desirable features of the single-phase Round-Wound are retained in the Tri-Wound, it is announced, including high impulse level, low exciting current, and high short circuit strength. Line Material Co.

## 23—MACHINE MOUNTS in larger size for heavier loads

A new larger Leveling Barrymount, the LM7 is available for carrying up to 10,000 lb per mount. Like this company's other self-leveling mounts, the new one is designed to let heavy machinery be installed and levelled within minutes, without bolting or shims. In addition to the mobility afforded machines, these mounts are said to offer several other benefits, including low installation costs and less wear and tear on adjacent machinery and on the plant structure itself, because Barrymounts isolate impacts generated during machine operation.

Better machining accuracy and better working conditions due to reduced noise are other advantages cited for these mounts. Also, there is claimed to be no "floor walking" of heavy machines, because these isolators absorb all modes of vibration (horizontal, vertical, rotational). The mounts are designed to permit height adjustment for leveling up to $\frac{1}{2}$ in. The Barry Corp.

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# CONSTRUCTION NEWS

**Los Angeles, Calif.** — Department of Water & Power, 207 South Broadway, has arranged a construction program to cost about $61,000,000, during fiscal year 1954–55. Of this amount about $24,000,000 will be used for steam-electric generating facilities, and $2,000,000 for hydroelectric power development. Other expenditures will include $3,000,000 for power substations and transmission lines, and $28,000,000 for extensions in distributing system, balance for miscellaneous construction.

**San Francisco, Calif.** — Pacific Gas & Electric Co., 245 Market St., has authorized an appropriation of $37,600,000 for construction of proposed Poe hydroelectric generating station on north fork of Feather River. Project will include a 60-ft. high power dam, with power house and two hydroelectric generating units with rating of 106,000 kw. A 6½-mi. tunnel will be built, also two steel penstock pipes for water supply.

**Palatka, Fla.** — Florida Power & Light Co., 25 South 2nd St., Miami, Fla., plans addition to steam-electric generating station at Palatka, with installation of equipment for increased capacity. Cost reported close to $1,500,000.

**Gary, Ind.** — Northern Indiana Public Service Co., Hammond, Ind., has plans under way for new steam-electric generating station at Gary, where tract of about 100 acres of land has been secured. Initial installation will consist of a 137,500-kw. turbine-generator unit, high-pressure boilers, water-treatment plant and auxiliary equipment. New station will be designed for installation of four additional generator units at later date, and will represent a reported investment of about $20,000,000.

**South Bend, Ind.** — Indiana & Michigan Electric Co. has arranged a construction budget totaling about $33,000,000 for expansion and improvements in plants and system during the 18-mo. period from July 1954 to December 1955, including increased generating capacity, power substations, transmission lines and other operating facilities.

**Kansas City, Kan.** — Board of Public Utilities will carry out expansion in new steam-electric generating plant now under construction, and which is scheduled to begin operation this fall with a rating of 40,000-kw. Extension program will include installation of a 44,000-kw. turbine generator, high-pressure boiler and auxiliary equipment, to be ready for service in 1957. Burns & McDonnell Engineering Co., 95th and Troost Sts., Kansas City, Mo., is consulting engineer.

**Wichita, Kan.** — Expansion program of Kansas Gas & Electric Co., 215 North Market St., for increased generating facilities, recently noted in these columns, will comprise an addition to Murry Gill steam-electric station, with work to include installation of new 115,000-kw. turbine-generator, high-pressure boilers and accessory equipment. This will be the third generator unit in this plant and will increase rating to 229,000-kw. Program is estimated to cost approximately $12,500,000.

**Louisville, Ky.** — Louisville Gas & Electric Co., 311 West Chestnut St., has plans under way for new steam-electric generating plant, to be known as Cane Run generating station. Proposed to begin work on first unit in near future. Entire program to cost about $16,000,000.

**Natchitoches, La.** — City Commission has authorized installation of new Diesel engine generator unit in municipal power plant for increased capacity, including complete accessory equipment. No estimate of cost announced. Barnard & Burk, 1023 Nicholson Dr., Baton Rouge, La., are consulting engineers.

**New Orleans, La.** — Louisiana Power & Light Co., Algiers, New Orleans, will expend about $17,000,000 during present year and extending into 1955, for expansion and improvements in power plants and system, including generating facilities, power substations, transmission lines, etc.

**Battle Creek, Mich.** — Michigan Carton Co., paper boxes and containers, will expend about $1,400,000 for extensions in power house at factory, recently referred to in these columns. Additional equipment will be installed for increased capacity and improved efficiency in operation. Work will proceed at once.

**Traverse City, Mich.** — Consumers Power Co., Jackson, Mich., has authorized plans for new headquarters and operating building at Traverse City, for Western Division, including repair and maintenance department, and other mechanical divisions.

**Minneapolis, Minn.** — Northern States Power Co., 15 South Fifth St., will expend close to $100,000,000 for expansion and improvements in plants and system, for 24-mo. period, 1954–55, a considerable part of appropriation to be used for increased generating facilities.

**Omaha, Neb.** — Omaha Public Power District, 17th and Harney Sts., has plans under way for addition to steam-electric generating station, including installation of new turbine-generator, high-pressure boiler and auxiliary equipment. Cost reported about $12,000,000, with switching stations, transmission lines and other operating facilities. Work is expected to begin in near future. Pioneer Service & Engineering Co., 231 South LaSalle St., Chicago, Ill., is consulting engineer.

**Reno, Nev.** — Sierra Pacific Power Co., Reno, will expend about $6,500,000 for 24-mo. period during 1954–55, for expansion and improvements in power plants and system, including increased generating capacity, power substations, transmission lines and other operating facilities.

**Atlantic City, N. J.** — Atlantic City Electric Co., Kentucky Ave., has tentative plans for new steam-electric generating plant at Beesleys Point, Cape May County. Installation will include turbine-generator unit of 100,000-kw. capacity, high-pressure boiler and auxiliary equipment. Cost reported about $18,000,000, including switching stations, transmission lines and other operating facilities.

**Oklahoma City, Okla.** — Oklahoma Gas & Electric Co., Oklahoma City, will make further extensions in steam-electric generating station, where work is now in progress on addition to increase capacity by 110,000-kw., expected to be completed in May 1955. Another new turbine-generator unit, 170,000-kw. rating and auxiliary equipment will be installed, scheduled for completion in summer of 1956. Company will expend close to $50,000,000 for this and other expansion during 1954–55, including power substations, transmission lines, other operating facilities.

**Ponca City, Okla.** — Municipal Water & Light Dept. plans expansion and improvements in oil engine-operated municipal electric plant, with installation of a 7450-kw. dual-fuel engine generator and complete auxiliary equipment. Cost estimated about $925,000. Work will be carried out in connection with extensions in water supply system. A bond issue is being arranged in gross amount of $2,838,000. W. H. Stueve, Oklahoma National Bank Bldg., Oklahoma City, Okla., is consulting engineer for power development.

**Avoca, Pa.** — Federal Creosoting Co., Hazel St., Clifton, N. J., plans boiler house at proposed new wood-treating plant for railroad crossties and other timbers at Avoca, near Pittston.

**Philadelphia, Pa.** — Philadelphia Electric Co., 1000 Chestnut St., has preliminary plans under way for new steam-electric generating station, on site in vicinity of city, now being selected. Installation will include a 275,000-kw. turbine-generator unit, high-pressure boilers and auxiliary equipment. Cost estimated close to $45,000,000, with transmission lines, power substations and other operating facilities.

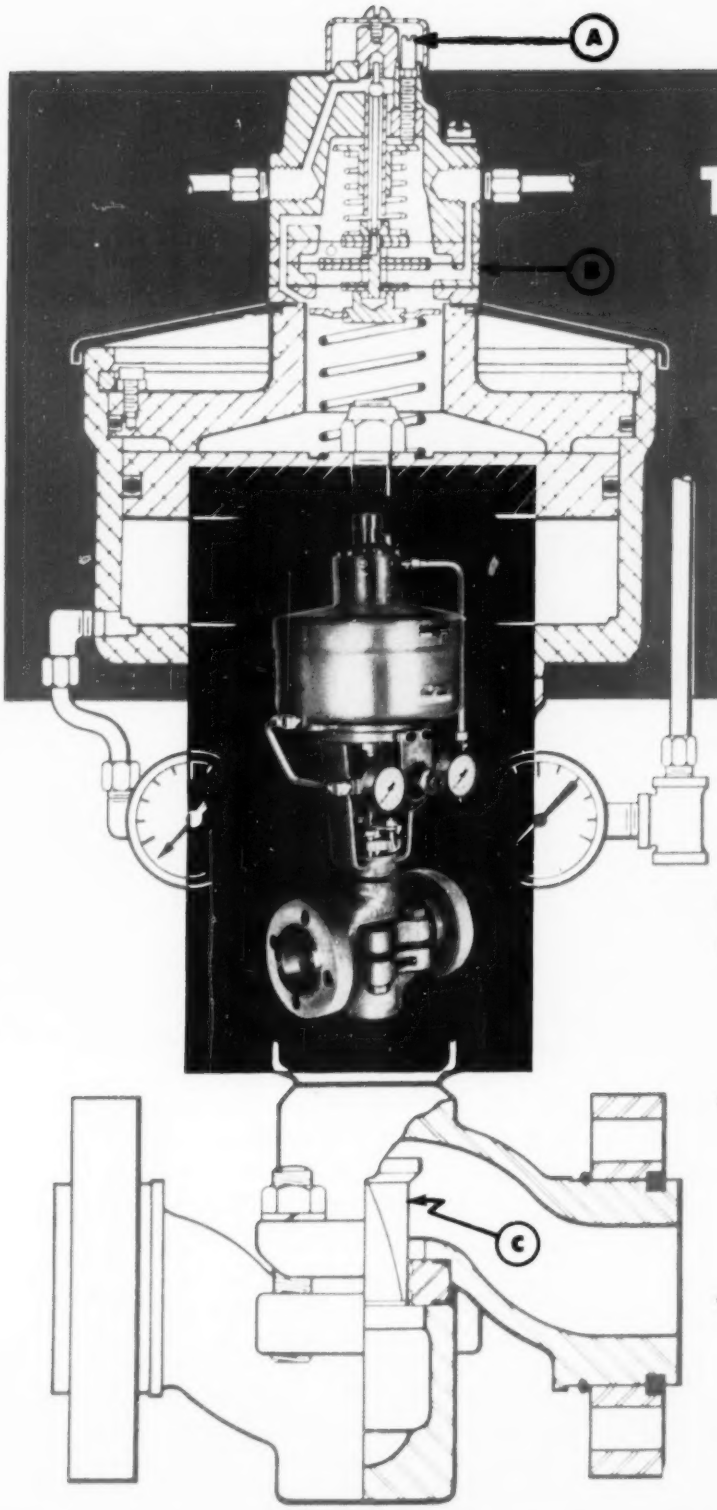
**Reading, Pa.** — Metropolitan Edison Co., 412 Washington St., is carrying out an expansion and improvement program in plants and system, to cost about $17,000,000, during present year and extending into 1955. Work includes extensions in generating capacity, transmission lines, distribution system, power substations, etc.

**Salt Lake City, Utah** — Utah Power & Light Co. has arranged financing, totaling about $20,000,000, fund to be used for 1954–55 expansion and improvement program of company, including generating stations, power substations, transmission lines and miscellaneous work. Project will include increased generating facilities.

**Kiel, Wis.** — Water & Light Dept. has secured permission from State Public Service Commission for installation of equipment for a municipal electric generating plant. It is understood that program will include a Diesel engine-generator unit.

**Madison, Wis.** — Wisconsin Power & Light Co., 122 West Washington St., is arranging financing to provide a fund of about $4,500,000 for expansion and improvements in power plants and system. A considerable part of appropriation will be used in connection with expansion of steam-electric generating plant near Janesville, Wis., on which work is in progress, to provide increase of 60,000-kw.

**Rhinelander, Wis.** — Rhinelander Paper Co. has plans maturing for new hydroelectric generator station on Wisconsin River, Oneida County, with installation to consist of two 1100 h.p. hydraulic turbines, each connected to a 600-kw. generator; one 1700 h.p. hydraulic turbine, connected to a 1000-kw. generator.

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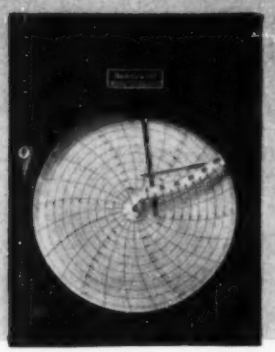
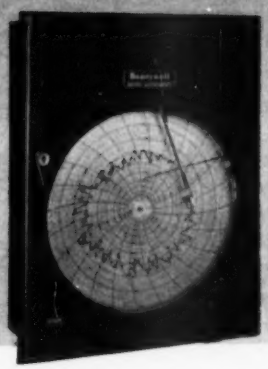
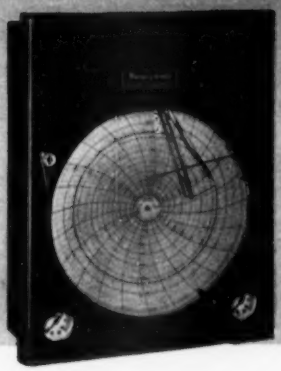


*Linear scale meters—mechanical or electrical types, all control forms.*

*Square root scale meters—mechanical, or electrical or pneumatic transmission . . . all control forms.*

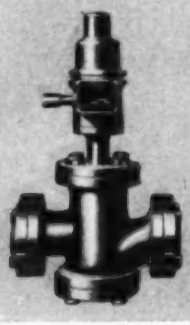


*Portable meters—versatility, for spot checks of flow values not continuously recorded.*

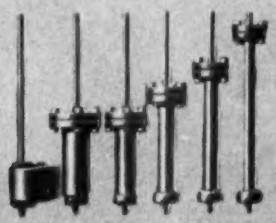


*Low pressure meters—either electrical or mechanical type, for air or gas flow.*

*Differential Converter—mercury-less pneumatic flow transmitter with infinitely adjustable range.*



*Area Type Meters for measuring flow of viscous fluids . . . electrical transmission.*



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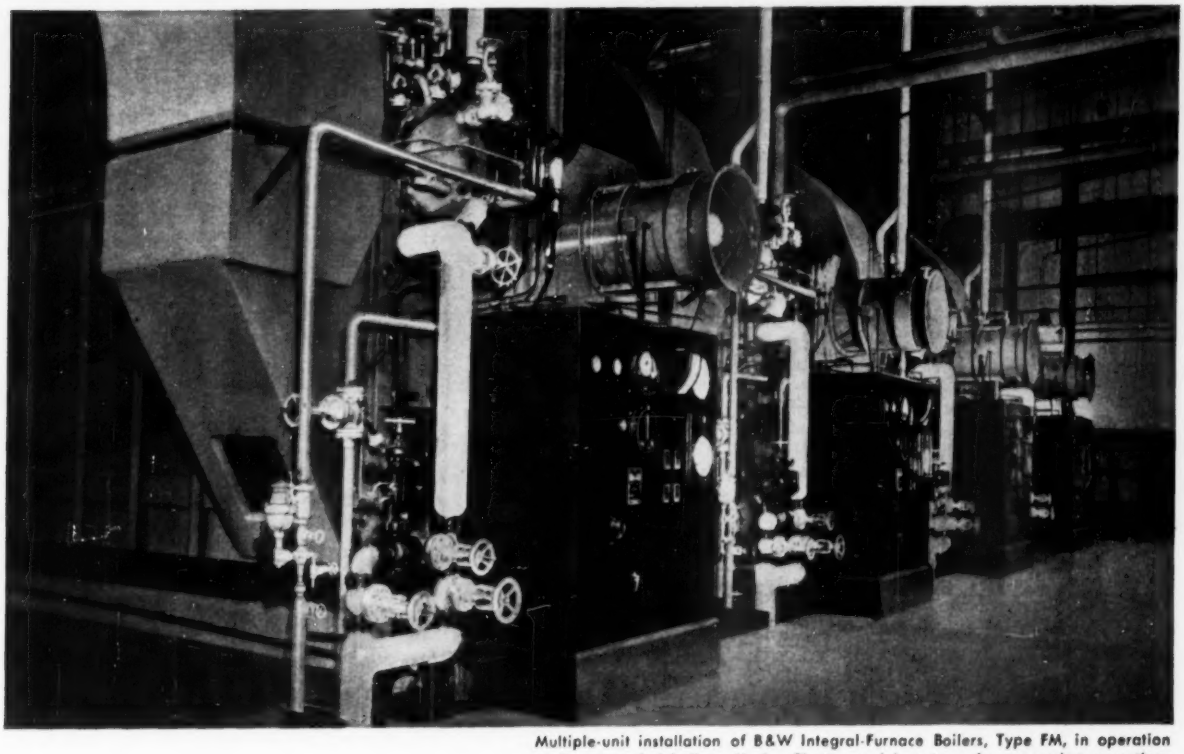
**For more data circle 533 on Post Card**

*keeping steam cheap . . .*

# THE YOUNGSTOWN SHEET AND TUBE COMPANY *installs* B&W Type FM Boilers



Multiple-unit installation of B&W Integral-Furnace Boilers, Type FM, in operation at the expanded Indiana Harbor Plant, supplying steam for processing operations and heating in the cold-reduction plant.

When The Youngstown Sheet and Tube Co. decided to extend its existing Indiana Harbor Plant at East Chicago, Ind., it made a choice between the installation of large or small boilers to meet the increased demand for steam.

Impressed by the compactness as well as the relative cost per pound of steam, company engineers selected four B&W Type FM Units—leaving space for a fifth unit—rather than two larger boilers, and, as a result, effected substantial savings in both installation and operation. Placed in service in November 1953, each boiler is oil-fired and has a steam capacity of 28,000 lb per hr. The four units are being operated in conjunction with three older B&W Boilers of greater capacities, to produce steam for both plant processing and heating.

The already large and growing acceptance of the B&W Type FM Boiler for a wide variety of industrial, commercial, institutional, and other applications rests on a solid record of service satisfaction . . . is reflected by the number of units now in service or on order, having a total steam capacity exceeding 9,000,000 lb per hr. Ideal for small to medium-sized plants, the FM Boiler is often selected even for larger installations—as at The Youngstown Sheet and Tube — to assure efficient, economical operation while avoiding the complete field erection and close operating supervision required by big boilers. It is available in standard sizes for loads ranging between 2900 and 36000 lb of steam per hr at pressures to 235 psi. Special units are obtainable for higher pressures.

The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-664

COST-SAVING FEATURES

- Saves Erection Time and Cost
- Meets Wide Range of Service
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

BOILER DIVISION

BABCOCK & WILCOX

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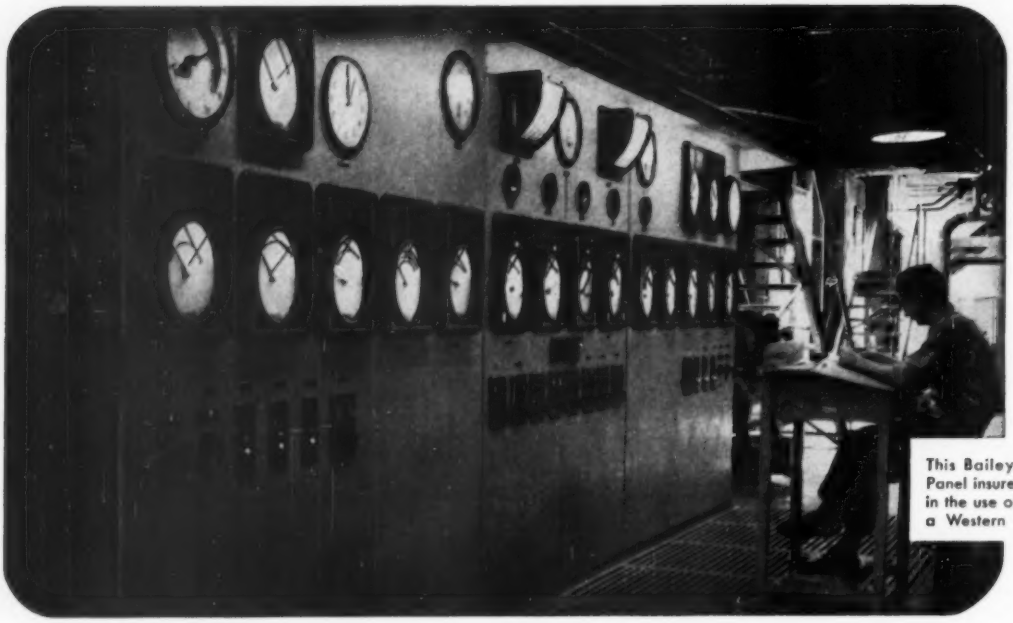

This Bailey Boiler Control Panel insures high efficiency in the use of Fuel-Dollars at a Western Chemical Plant.

# What's Your Fuel-dollar Efficiency?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-109-1

BAILEY METERS

**BAILEY METER COMPANY**

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

*Controls for Steam Plants*
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

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Refractory concrete made with castables is the *adaptable* refractory—can be easily placed in any size or shape . . . resists severe thermal shock and spalling. It can be poured, troweled or "shot" on by cement gun, and it's ready for service in 24 hours or less.

For additional information, write Lumnite Division, Universal Atlas Cement Company, (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y. or contact any of the offices shown below.

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*"*LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

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**ATLAS®** **LUMNITE for INDUSTRIAL CONCRETES**

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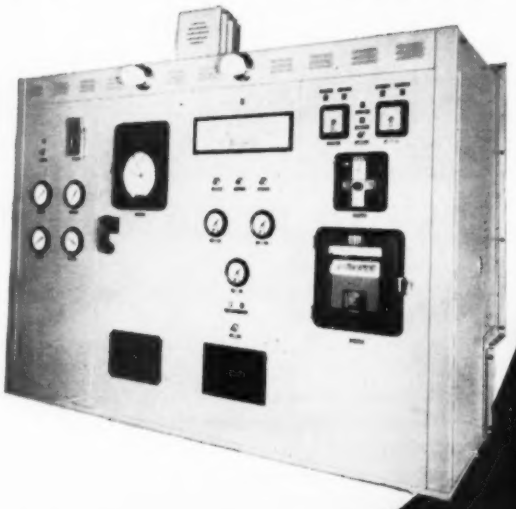
Steel and alloy fabrication . . . sheets, plate and light structurals . . . has been a Kirk & Blum specialty for more than 47 years. Exceptional experience and complete facilities up to ⅛" in steel, stainless, aluminum, monel and other alloys.

Send prints for prompt quotation or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication catalog. The Kirk & Blum Mfg. Co., 3230 Forrer St., Cincinnati 9, Ohio.



KIRK AND BLUM
SHEET METAL FABRICATION

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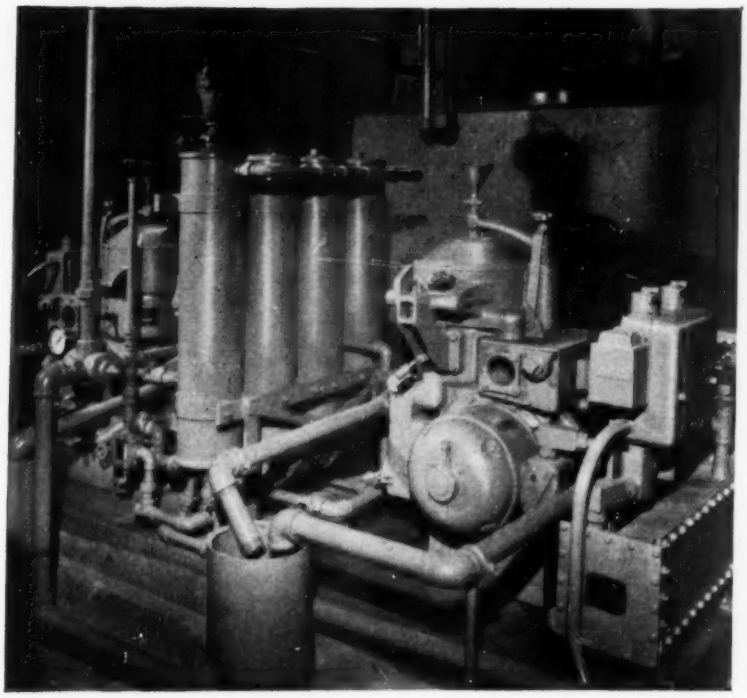

**YOU KNOW** that every bit of solid contaminant is being removed—even down to particles as fine as *one micron* (0.000039 in.) . . . . .

**YOU KNOW** that every drop of water is being taken out of the oil . . . . . .

**YOU KNOW** that ring sticking is being practically eliminated, time between crank case cleanings stretched out, oil life prolonged . . . . . .

**YOU KNOW** that you've provided the utmost in dependability—a De Laval "Puri-Filter" will never let you down.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York • 427 Randolph St., Chicago 6
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# DE LAVAL

## LUBRICATING OIL PURIFIERS

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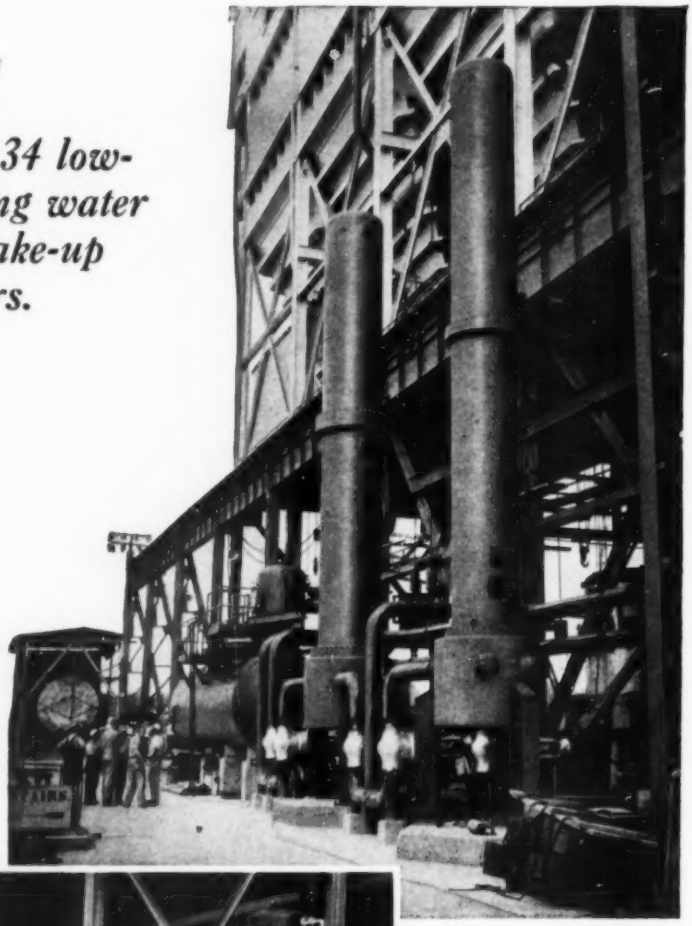
# *68 units to serve*
# JOPPA STEAM-ELECTRIC STATION

***Feedwater installation by Foster Wheeler includes 12 high-pressure heaters, 34 low-pressure heaters, 18 cooling water exchangers (including make-up heaters) and 4 evaporators.***

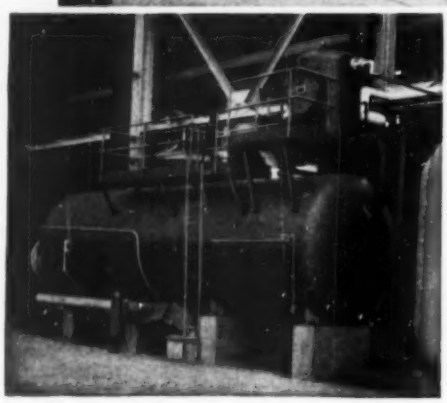
Constructed by Electric Energy, Inc. to supply approximately half of the power for AEC's Paducah Area Project, the Joppa Steam-Electric Station is designed for 937,500 KW in six boiler and turbine units. Of the semi-outdoor type, it represents one of the largest electric power stations ever planned for one building operation.

Few installations require the number of heaters which this new station will have when completed; probably none can boast of larger high-pressure heaters. The six crossover high-pressure heaters each have a surface of 7,760 sq ft capable of heating 1,162,700 lb of feedwater per hr from 411.1 F to 470.4 when supplied with steam at a pressure of 497 psia, total temperature of 721.1 F. The six 10th-stage high-pressure heaters each have 4,858 sq ft surface. Each set is equipped with desuperheating, condensing and drain-cooling sections, and is built for handling 3200 psi, 500 F water.

The closure for these high-pressure heaters incorporates the well-known "Lockhead" feature. A patented Foster Wheeler construction, this closure provides a means for supporting the head pressure load that is separate from that for supporting the gasket compression load. Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.



▲ Crossover and 10th-stage feedwater heaters. Crossover heater is approximately 38' high. Shell design pressure is 550 psi at 800 F; tube design pressure 3200 psi at 500 F.



◀ Foster Wheeler evaporator with deaerating preheater. Total heating surface 3450 sq ft capable of evaporating 30,000 lbs net vapor per hr.

**FOSTER WHEELER**

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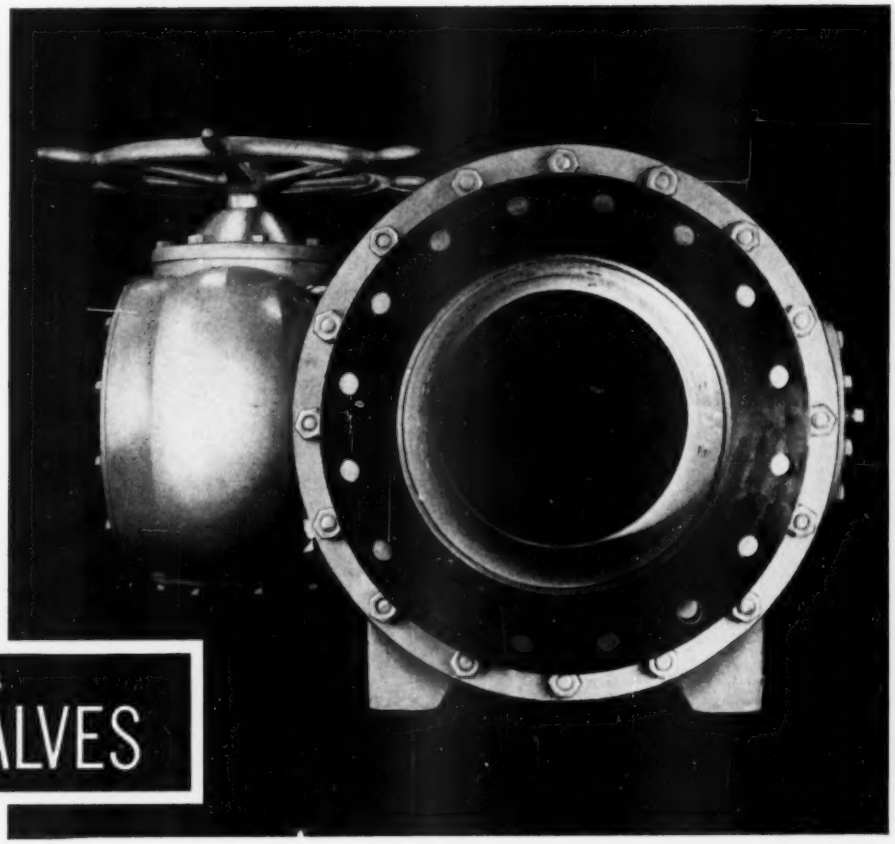

SMS
# BALL VALVES

## a new achievement in valve performance . . .
## STRAIGHT-THROUGH FLOW WITH DROP-TIGHT CLOSURE

For the path of least resistance – the new SMS-Ball Valve has no equal in design or price. When open, the valve is like a straight piece of pipe – nothing to resist flow and create resultant pressure drop, thereby reducing pumping costs. Elimination of turbulence adds to valve and pipe life.

**EASE OF OPERATION** – Forces required for opening and closing are remarkably low, even under adverse conditions. The tremendous leverage exerted by the operating mechanism affords complete ease of operation. Flow velocity tends to ease closing.

**TIGHTNESS OF CLOSURE** – Drop-tight closure is obtained by the wedging action of the metal-to-metal seats.

SMS-Ball Valves afford high performance at significant in-place savings. Costs compared to valves giving similar performance are appreciably less. Write for our new Ball Valve folder.

This new valve, as well as our full line of cone and butterfly valves, is backed by over 75 years experience in hydraulic design and research. For full information on your valve problem, check with your local representative, or write to S. Morgan Smith Company, York, Pennsylvania.

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# S. MORGAN SMITH CO.

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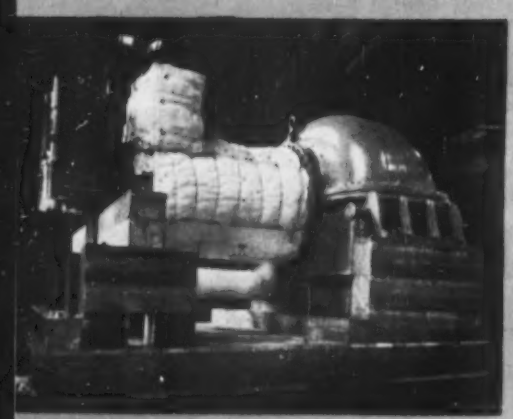
# Another

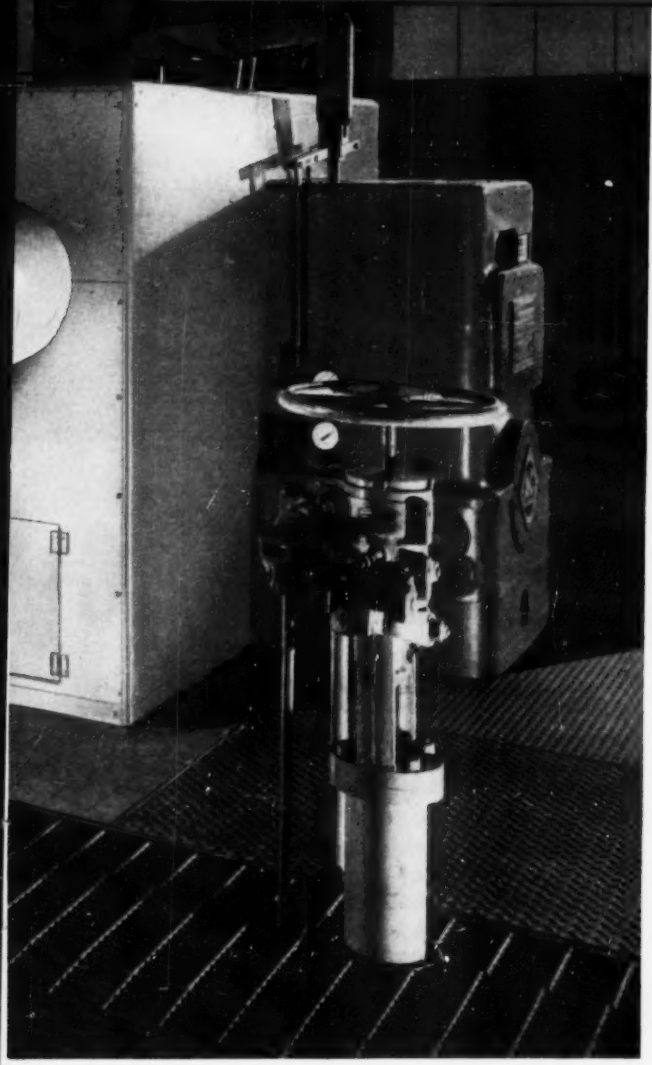


To simplify installation, both turbine and generator are shipped as complete assemblies with rotors locked in place. Turbine insulation is also applied at factory. Illustration at left shows 7500-kw turbine ready to be covered with tarpaulin before shipment.

Attractive appearance of WA-Series turbine and generator is shown above. Unit is rated 7500 kw, with steam conditions of 600 psig, 825 F, 1½ inches mercury absolute. A-C also supplied surface condenser, pumps and motors for this installation.

*WA-Series*

# STEAM TURBINE GENERATOR UNIT



## Engineered to Meet Requirements of a Modern Power Plant!

HERE'S another Allis-Chalmers WA-Series turbine generator unit with the kind of design features and performance that power producers everywhere are looking for today.

Available for condensing and non-condensing service, the up-to-date WA-Series impulse turbine design is built in sizes 2000 kw and larger in NEMA standard ratings. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

### Simplicity is Keynote

For ease of installation and maintenance, every detail has been designed to assure maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit with simple foundation requirements. And shipment of the turbine and the generator with their rotors in place further minimizes installation costs.

Completely coordinated in design, these modern generating units are manufactured, assembled and tested in one plant under unified supervision.

For a detailed story of the WA-Series features that can help you reduce costs, ask your A-C representative for Bulletin 03B7654, or write to Allis-Chalmers, Milwaukee 1, Wis.

A-4112

# ALLIS-CHALMERS

A-C ALLIS-CHALMERS

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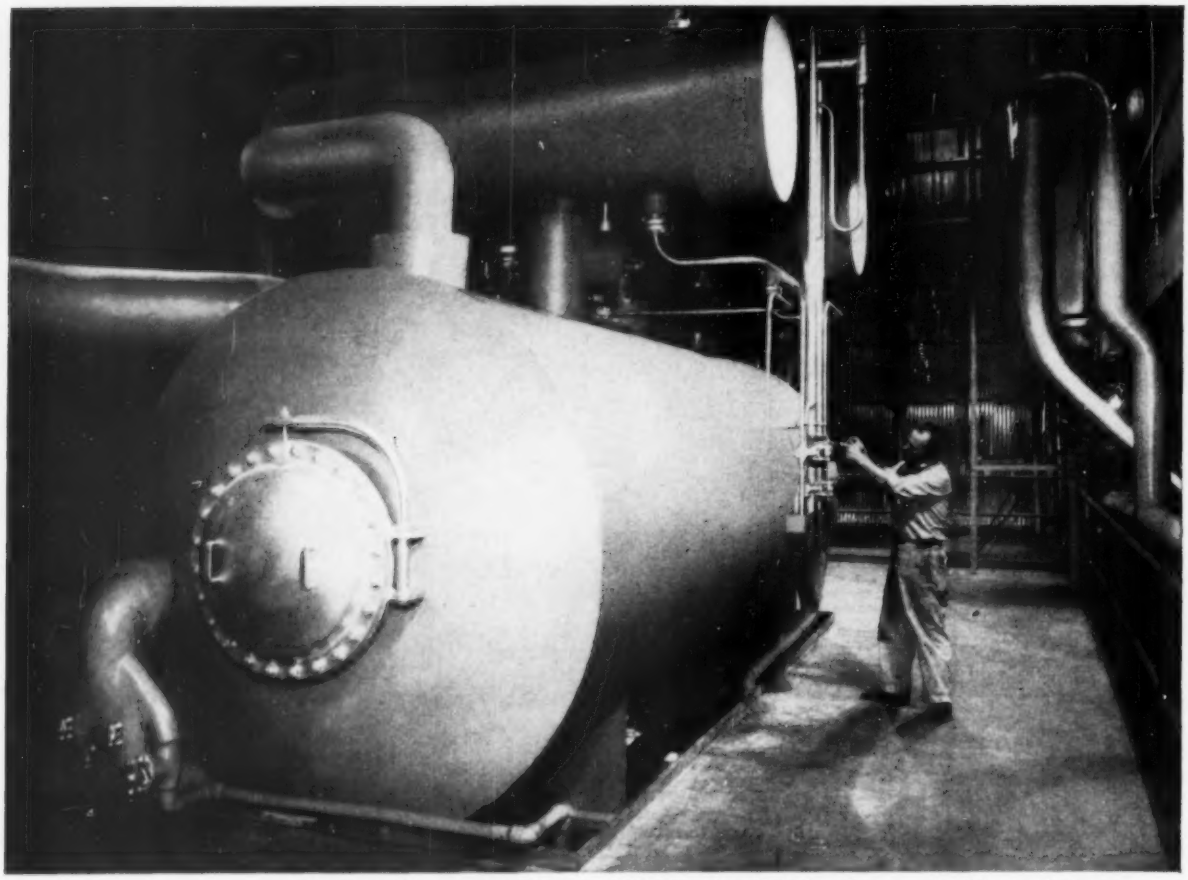


**ONE OF SEVEN WORTHINGTON DEAERATORS** installed by Stone and Webster Engineering Corporation, engineers and constructors for Virginia Electric's growing power system.

# Now there are seven Worthington deaerators at Virginia Electric and Power Company

Back in 1939, the Virginia Electric and Power Company first started buying steam power equipment from Worthington.

Since that time, VEPCO has installed seven Worthington direct-contact deaerators in new or existing stations, the latest deaerator going to work in 1953.

There's a good reason for all this repeat business — *performance*. Worthington deaerators, like all Worthington steam power equipment, are built for service, built to keep going year after year under the most rigorous operating conditions. Features like easy tube accessibility, Worthington's patented tray system and specially designed distributing weirs add up to economical, dependable operation — with extremely low maintenance costs. Matter of fact, we think our deaerators are the best salesmen we have.

Get in touch with your nearest Worthington district office for bulletins and information. Or write to Worthington Corporation, Steam Power Division, Section S.4.1, Harrison, New Jersey. S.4.1

**"SEE the Worthington Corporation Exhibit in New York City. A lively, informative display of product developments for industry, business and the home. Park Avenue and 41st Street."**

**WORTHINGTON**

**A GREAT TEAM IN STEAM**

**Steam-Jet Ejectors and Vacuum Pumps** • **Boiler Feed Pumps** • **Deaerators** • **Steam Turbines** • **Surface Condensers and Auxiliaries**

**For more data circle 542 on Post Card**

# For low-cost, dependable steam, Upjohn burns coal the modern way

Upjohn has long been famous as a manufacturer of pharmaceutical products. Because of the nature of these products, it was necessary that the steam plant of Upjohn's new Portage Road Plant, near Kalamazoo, Michigan, operate cleanly as well as economically. Therefore, coal was chosen to fire its boilers.

Today Upjohn's ultramodern steam plant supplies steam at only 40c to 42c per 1,000 pounds. It is clean and efficient, with no dust or smoke nuisances, and ash handling is fully automatic. At peak load, the three boilers shown above, plus a fourth recently installed, deliver up to 115,000 lbs. of steam per hour.

## Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars every year.

## *facts* you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems can cut your labor cost to a minimum.

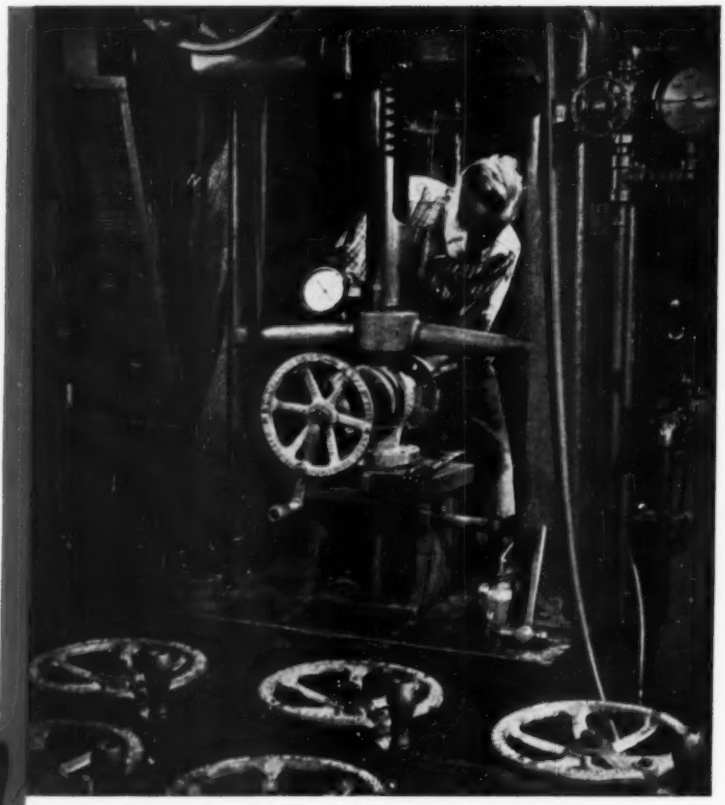
Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

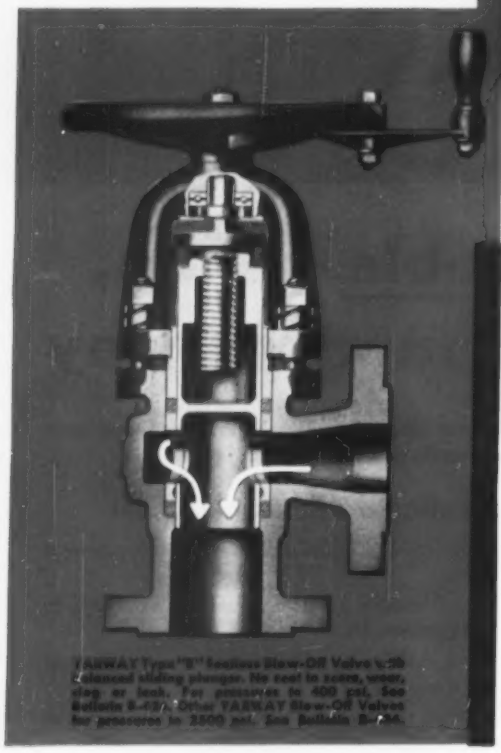
Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

**BITUMINOUS COAL INSTITUTE**

A department of National Coal Association • Southern Building, Washington 5, D.C.





# THIS PRODUCTION "DOUBLE CHECK" SAFEGUARDS YOUR BOILER INVESTMENT!

■ Yes, here is one extra production step we will never bypass! It is your guarantee of a *dependable*, long-life blow-off valve.

In this corner of the YARWAY Testing Department, *every Yarway Blow-Off Valve* is hydrostatically tested at 1½ times its rated maximum working pressure—proved drop-tight for service far beyond normal expectancy.

Not only blow-off valves, but *all* YARWAY equipment undergoes rigorous tests before leaving the YARWAY plant. Why? For one reason—to assure longer and better service in *your* plant. Over 15,000 boiler plants are using YARWAY Blow-Off Valves—some for twenty-thirty years, or longer.

Whenever you are in need of boiler blow-off valves, be sure to *make Yarway your way*.

**YARNALL-WARING COMPANY**
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

**YARWAY steam plant equipment**

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
REMOTE LIQUID LEVEL INDICATORS
EXPANSION JOINTS
DIGESTER VALVES
STEAM TRAPS
STRAINERS
SPRAY NOZZLES

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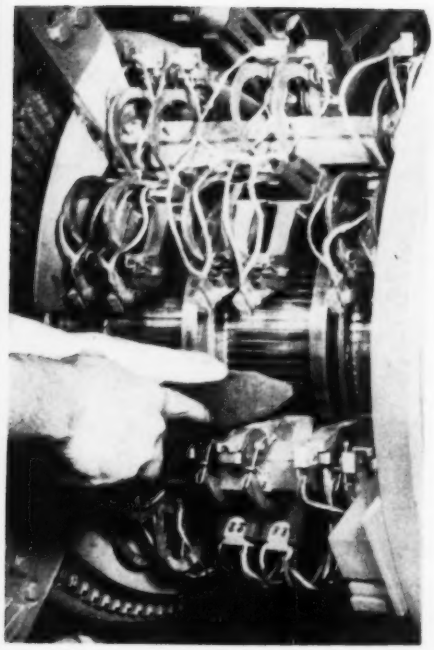


# How to Handstone a Commutator

By R. L. TAUSCHER*

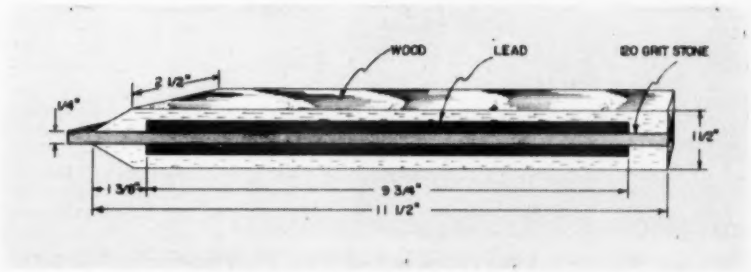



Fig. 1. Home-made assembly for use with a small light-weight handstone

Fig. 2. (Left) Using handstone on commutator of high-speed exciter, at reduced voltage, with brushes lifted in span being stoned. Full instructions are given in text

HANDSTONING of commutator bars is a very old art and still a very useful one for many applications. Because of the comparatively small use of this method in recent years, it seems to have accumulated an aura of mystery, assigning it largely to the class of old-master hand arts whose artisans have since faded away. It is true that handstoning has some rather special do's and don'ts but few if any of these require great practice before they can be accomplished.

Handstoning of d-c machines can be divided into two classes: first, turbine generator exciters turning at 3600 rpm; second, industrial type motors and generators. Much more meticulous care is required when handstoning turbine generator exciters than when handstoning industrial type motors and generators.

### Why Handstoning?

Handstoning technique was developed for combating bar-to-bar roughness, which is one of the worst offenders of good commutation. This condition is not caused by mechanical shifting of the bars, but is due to sparking and electrolytic action within the arc.

High-speed turbine generator exciters are a special "breed of cats." For example, turbine generator exciters usually operate at 3600 rpm, even up to ratings as high as 300 kw. Because of this high speed, they are built with a special design of commutator not found on standard industrial machines. Turbine generator exciters use a shrink-ring commutator whereas standard machines almost always use the V-ring commutator. Construction of the shrink-ring commutator is such that bar-to-bar roughness due to *mechanical* slippage of one bar on another is a rarity indeed.

The degree of bar-to-bar roughness can be determined by using a sharp-pointed stick, shaped like a pencil. The pointed end is placed on the revolving commutator at a slight inclined angle in the direction of rotation. On a commutator with negligible bar-to-bar roughness, the stick will feel as if it is moving over a smooth glass surface.

For a commutator rotating at high speed this method is much more sensitive than the dial indicator, which cannot follow the rapid vibration. However, on industrial machines, a dial indicator is satisfactory, especially if the commutator is turned over slowly.

One of the main advantages of handstoning turbine generator exciters is that they can be handstoned when running at 3600 rpm and at no load or at about half load with the brushes lifted on the span being handstoned. This obviates shutting down the large generator (a-c generator) due to commutator trouble on the relatively small exciter. Since this handstoning is done at 3600 rpm, a smooth pointed stick is much more sensitive than a dial indicator.

### Select Right Stone

Quite naturally, the first principle in handstoning is the selection of the stone itself. Handstones are usually classified as coarse, medium and fine. The coarse stone has a grit of about 80 mesh and is used to remove a large amount of copper. It is seldom used, however, because it is often better to take a lathe cut off the commutator surface. The medium stone has a grit of about 120 mesh and is used for the bulk of the grinding work. The fine stone has a grit of about 200 mesh and is used only to obtain a fine finish. Two types of 120 grit stones are in common usage:

1 — A $1\frac{1}{2}$ by $2\frac{1}{2}$ by 12-in. stone. The large mass of this stone prevents it from following bar-to-bar roughness. The contact tip of the stone should be ground to approximately $\frac{1}{4}$ in. for best results.

2 — A smaller stone may be used if the mass of the stone is retained by means of lead weights located as shown in Fig. 1. This stone can be used to a much smaller length and does not require sharpening.

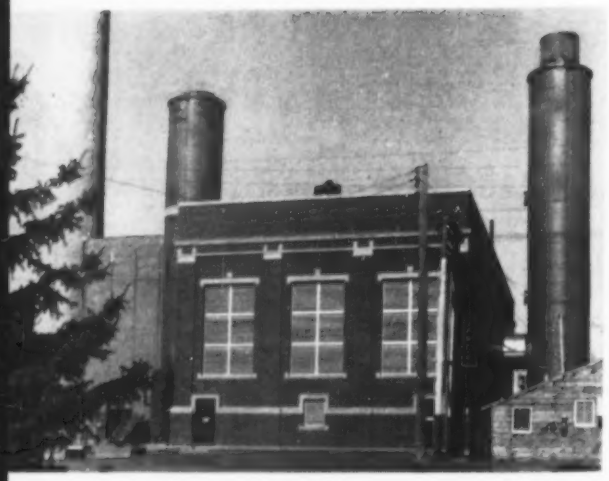
As mentioned, one of the more important applications of handstoning concerns high-speed exciters. High-speed turbine generator exciters have extremely high commutator speed — often more than 2 miles per min. Consequently, the commutator must have the highest finish practicable. Handstoning by a gri. stone of large mass is superior to using a grinding rig, because the rig will transmit all the vibrations of the generator into the commutator finish. Handstoning of 1800 and 3600-rpm exciters can be done at reduced voltage with all brushes lifted in the span being stoned as shown in Fig. 2. If, during the process, commutation becomes bad, it is necessary only to blow out the machine with an air hose.

### On High-Speed Exciters

There are several points to follow when handstoning high-speed turbine-generator exciter commutator bars. Follow these, and the handstoning technique will be easy to master:

1 — Lift all brushes in the span to be stoned. Steady the stone on the brushholder *continued on page 113*

*Industry Engineering Department, Westinghouse Electric Corp., East Pittsburgh, Penna.



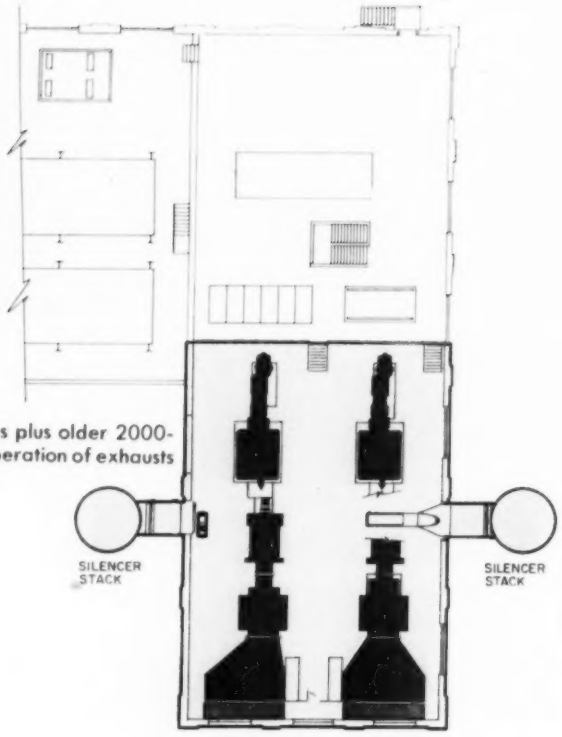



Fig. 1. Conventional building houses two 4000-kw gas turbines plus older 2000-kw steam turbine plant. Different stack elevations prevent reverberation of exhausts

# Williston "Boom" Powered by Gas Turbines

**Oil discovery near Williston, N. D., caught the utility with its power down. Two 4,000-kw gas turbines gave (relatively) quick relief without offending residential neighbors of the expanded plant**

**BY W. VAN TASSEL ***

DISCOVERY of oil in the Williston, North Dakota vicinity early in 1951 accelerated economic development of the area to an abnormal rate. The attendant rapid increase in population and business activity resulted in very sharp and substantial increases in the demand for and consumption of electric power.

The City of Williston was served by Montana-Dakota Utilities Co. with a 2000-kw. steam plant and ties to other steam plants at Glendive, Montana and Columbus, North Dakota. The major portion of the power actually distributed in the area was supplied from a 114-kv USBR line originating at the Fort Peck, Montana hydro-electric plant operated by the U. S. Army Engineers. The steam plants served principally as voltage regulating and peaking capacity, but were capable of handling requirements of the area, prior to the accelerated economic development noted above, in event of transmission failures.

By October 1951, it was obvious that to assure Montana-Dakota Utilities Co. customers in the Williston area a firm and satisfactory power supply would require the earliest possible addition of sufficient generating capacity to meet immediate needs and prove an economic capacity increment serving future rapid load growth of a nature and extent not predictable by conventional formulae.

The selection of gas turbines to meet the requirement was based upon these four factors:

1. Gas turbines are package power plants, having very moderate foundation space and piping requirements, making possible rapid construction progress and an early operating date.

2. A company owned and operated gas transmission line would serve the majority of fuel requirements, and the petroleum fuel supply outlook in the area was excellent. In this regard, the gas/oil dual fuel capabilities of the gas turbine were considered advantageous.

3. Due to limited ground water supplies and the cost and complexity of developing a suitable intake on the expected meandering channel of the Garrison reservoir headwaters, the moderate cooling water requirements of the gas turbines were highly advantageous.

4. Since no heat balance or engineering matching of major equipment was required, gas turbine selection would minimize engineering time and cost.

### Thirteen-Month Delivery

After conferences with engineers of the General Electric Company, a tentative order was placed with that manufacturer for two 3900 kw simple cycle dual fuel gas turbine driven generators, with all accessory equipment, to be delivered in July and August of 1953. This tentative order permitted the manufacturer to allocate production time to fabrication. The manufacturer was supplied confirmation of the order and instruction to begin fabrication on May 2, 1952, thus allowing thirteen and fourteen months respectively for fabrication and delivery of the units to Williston. Despite this short delivery time, the manufacturer met the requirements of the construction schedule.

Ebasco Services Incorporated of New York had been engaged to design and construct the gas turbine plant and act as purchasing agent in dealing with the manufacturers and vendor of equipment.

* Superintendent of Electric Production, Montana-Dakota Utilities Company

Ebasco submitted a preliminary project outline on May 8, 1952, proposing extension of the existing steam electric station building to serve the two new units and indicating unit operating dates of October and November of 1953.

In April 1953, Ebasco submitted a cost estimate based on engineering and drawings already completed and in process. This cost estimate proved so accurate that it is presented in abbreviated form as actual cost, with modifying comment as required. The cost estimate covered such repairs and alterations as were required to extend the existing steam electric facility as well as the costs of the installation described herein.

The station building is a steel frame brick building, 80 feet by 44 feet by 32 feet high, closely matching the design and architectural features of the old power plant structure. Building equipment includes the usual heating and ventilation, lighting and fire protection. Crane rail extension permitted the existing crane to be utilized. An additional single cell Marley Co. cooling tower supported on a reinforced concrete basin was erected and piped to serve the gas turbine generators. For oil storage, a 5,000-barrel oil storage tank was erected on a sand and gravel foundation and enclosed by an earth dike. A 5,000-gallon buried day tank and suitable unloading and transfer pumps were provided.

A brick and concrete gas metering building, 17 feet by 14 feet by 10 feet, with suitable meter runs and pressure reducing valves were also provided as part of the fuel system.

Since gas transmission line pressures under heavy gas load conditions could drop below requirements for full gas turbine load, two Gardner-Denver motor driven booster compressors with suitable aftercoolers, regulators and receivers are provided. These units are housed within the gas turbine building directly below the main air intake filters.

### Rating vs Capacity

Turbine generator units are each rated 3900 kw at station conditions (4,000 kw standard conditions), gas or oil fired, and have since proved each to have a 5,000 kw capability firing with either gas or oil. Each unit includes an axial flow compressor, six combustors, two-stage gas turbine, reduction gear, generator, exciter, starting motor, lube oil and governing system, accessories, controls and instrumentation.

The cooling water system within the plant includes three circulating water pumps with piping to the various points requiring service on both gas turbines and the cooling tower. Each pump is rated 325 gpm, which amount of water at 85 F. is sufficient for one gas turbine.

An air intake system is provided for each gas turbine, and includes for each an intake filter and silencer, expansion joint, duct work, low temperature insulation, and steel column supports. The filters in the intake system are American Air Filter Company 20x25x4-in. type MW-4 cells framed into a "V" arrangement for each unit. Each filter cell is individually removable for cleaning and recharging with a viscous fluid. Inlet louvres are flush with the building wall and all filters and duct work are inside the building.

### Muffler Stacks

Each turbine is provided with an exhaust system, the main feature of which is a combination muffler and stack on a reinforced concrete foundation, with necessary expansion joints, duct work, high temperature insulation and necessary support steel. Duct work is suspended on constant support hangers to prevent transfer of expansion stresses to the gas turbine exhaust heads.

Main generator voltage is 12.5 kv and all switchgear is metal clad General Electric equipment. The auxiliary circuits are 440-volt and also feature metal clad switchgear throughout. Auxiliary electric equipment includes a station battery, a motor-generator charger and panel, and three single phase 30-kva auxiliary power transformers. Service and cooling water supply, sanitary facilities, office and stores area were all normal site improvements available from the existing facilities.

On the initial estimate, labor was included on a straight time basis at current rates for a 40-hour week with reasonable allowance for overtime to keep construction in balance. A breakdown of costs is presented in the table in abbreviated form, but it should be noted that these costs do not include the main substation, the basic cost of the 5,000-barrel fuel oil tank, nor the cost of the three-phase auxiliary power transformers. The estimate does include the *installation* costs of the latter two items, but the main substation and its associated control equipment were purchased and installed by Montana-Dakota Utilities Co. as a separate project in connection with development of a 12.4 kv distribution system.

### Startup Delays

As may be expected during installation of a new and unfamiliar type of equipment, there were some minor delays and difficulties that further experience on the part of the manufacturer, consultant and operating company would undoubtedly eliminate. None of these delays were serious or of major consequence, but they did retard initial operation of the first unit thirty days beyond the planned operating date. No particular item of delay was of sufficient consequence to note herein, nor did any delay add appreciably to the construction cost of the project.

Operating experience with the installation is still considered limited, as the first gas turbine went into trial operation in November 1953 and the second unit in December 1953. Final

Fig. 2. Gas turbines' common cooling tower gets freeze protection from doors, steam turbine condenser water

Table of Williston addition costs. Equipment costs for main substation, oil tank and auxiliary transformers are omitted, but last two installation costs are given

| Item | | Cost | Cost Per KW of Capability | |
|---|---|---|---|---|
| Structures and Improvements | | $ 140,000.00 | $ 14.00 | |
| Fuel Holders, Producers and Accessories | | 39,000.00 | 3.90 | |
| Gas Turbine Electric Generating Units | | 1,109,000.00 | 110.90 | |
| Accessory Electrical Equipment | | 104,000.00 | 10.40 | |
| Miscellaneous Power Plant Equipment | | 3,000.00 | .30 | |
| Retirement Work in Progress | | 1,500.00 | .15 | |
| Indirect Construction Costs | | 110,000.00 | 11.00 | |
| Onissions and Contingencies | | 48,500.00 | 4.85 | |
| Specific Construction Cost | | $1,555,000.00 | $155.50 | |
| Overhead Construction Costs | | $ 195,000.00 | $ 19.50 | |
| Engineering | 72,000.00 | | | $ 7.20 |
| Engineering and Construction Fee | | | | |
| Legal and Taxes during Construction | | | | |
| Injuries and Damages | 123,000.00 | | | 12.30 |
| Engineering and Administration | | | | |
| Interest during Construction | | | | |
| Land and Land Rights | | None | | |
| TOTAL PROJECT COST | | $1,750,000.00 | $175.00 | |

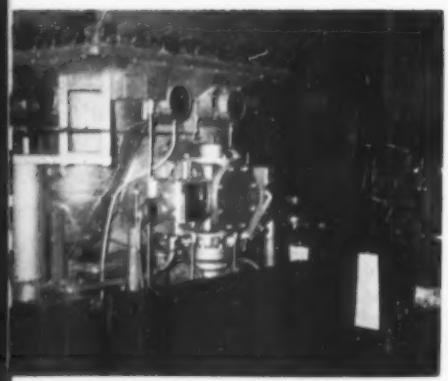


Fig. 3. No. 1 bearing with start-up-shut-down and dc emergency oil pumps; the 1000-gal oil tank is below

## . . . Williston Boom

adjustment of equipment and plant completion occurred in May 1954. Both units were initially fired on oil and have demonstrated capability beyond 5000 kw on this fuel. The limiting factor on capability under ambient temperature conditions prevailing to date has been the manufacturer's recommendations. Loads to 5000 kw per unit have been carried for test purposes on natural gas.

*Fifteen hours of classroom instruction in gas turbine operation was supplied to plant operating personnel. This, plus operator observation of erection procedures as the station took shape, proved sufficient to orient them in proper care and operation of the units.*

Startup record forms were developed to record every load pressure and temperature observation that could be secured from installed instrumentation. These were not intended as station log sheets, but were instead planned for reference in evaluating future gas turbine performance against performance of the units as initially experienced.

As of April 3, 1954, the first unit installed had a total accumulated fired time of 88 hours at an average load of approximately 2100 kw. The second unit had a fired time of 143 hours at an average load of approximately 1600 kw. The relatively light loading is due to the fact that the units were operated primarily for reactive support and peaking with preferential base load carried on the U. S. Bureau of Reclamation tie lines.

Throughout the load range of the units, governing has proved satisfactorily stable. During warm-up, there is a noticeable tendency for the gas turbines to pick up load, but this tendency disappears after a few minutes of loaded operation during which thermal equilibrium is attained.

After a manually-supplied starting impulse, and manual pressurizing of cooling water and fuel supplies, the starting sequence of the units is entirely automatic up to the point where the unit is up to speed (6868 rpm) and ready to be phased in. Switching and loading procedures and controls are conventional. Interlocking relays prevent initiation of the starting sequence unless pressure conditions of lube oil, cooling water and fuel are within preselected limits. All automatic supervisory controls are "fail-safe" and will interrupt a starting sequence upon ignition failure, or delay, or any other malfunction. Once "up to speed," automatic shutdown will follow an alarm indicating a malfunction, unless corrective measures are completed within predetermined limits.

The quick starting ability of the units is of great value for the service conditions they were selected to fulfill. *Starting time from "at rest" to "phased in" averages about eleven minutes*, and warm starts of nine minutes have been observed. Prior to firing, there is a five minute purge period with the 250-hp cranking motor rotating the unit. Subsequent to firing, at about 1200 rpm and especially after the cranking clutch automatically disengages, the acceleration rate is very high; however, no excessive vibration has been observed during this rapid acceleration. The cranking motor assists acceleration to approximately 4000 rpm.

As the plant is located just across the street from a well developed residential area, there was considerable concern that the gas turbines, despite intake silencers and exhaust mufflers, would elevate the neighborhood noise to objectionable levels.

### Noise Survey

After installation of the gas turbine units, two noise surveys were made, one with the steam turbine running alone and another with the steam turbine operating and with one gas turbine operating at rated load. A complete analysis of these surveys is not presented here, but some typical results are of interest.

At locations that could be considered representative of a possible source of complaint, the normal noise level was determined to range from 62 to 71 db (decibel) with no gas turbine running. Normal truck traffic passing the plant raised this level to 79–90 db. With one gas turbine running, the noise level at the selected locations increased 10 db, and then only with the wind in a sector favorable to noise transmission. *With the wind blowing from the residential side of the street toward the plant, it is not always possible to determine from the sound level that a gas turbine unit is in service.*

Combination stacks and mufflers serving the Williston gas turbines were manufactured by Burgess-Manning and are believed to be the largest such devices in existence. They were moderate in cost, however, and may be considered a good investment.

Representatives of a prominent manufacturer of jet aircraft engines have visited this successful installation in the course of studies aimed at reducing the noise level of test cell operation of jet propulsion units.

The noise survey included locations within the station, and determinations ranged from a maximum of 98 db in the 75–100 cps frequency band to a maximum of 80 db in the 4800–10,000 cps band. These were at the most disadvantageous locations in the center aisle between the turbines. As compared to steam turbine plants, the general noise level within the station is not unusual or objectionable in volume, frequency or character.

Intake filters and associated silencers are very effective; noise at the air inlet louvres is only a low level rushing air sound. Pressure drop across the filters is higher than predicted, but tests have indicated that this greater pressure drop is due to turbulence created by the closely-spaced, slanted-intake louvres. These louvres will be modified to provide an undisturbed laminar air flow, and there is every reason to expect that this will bring filter pressure drop to predicted levels.

Operation during a heavy snow and sleet storm demonstrated that the filter will load with ice crystals. Regular operating practice is to remove a substantial block of filter cells or sections under such conditions. The filtering arrangement is for the primary purpose of excluding dust from the compressor, thus eliminating efficiency-destroying deposits on the axial flow compressor blades. Although inspection subsequent to operation during a heavy snow storm showed no evidence whatsoever of ice crystal erosion of compressor blading, the manufacturer has to date reserved approval of operation with filter cells removed.

### Operating Experience

The relatively limited operating experience to date has precluded development of long term efficiency data. The manufacturer's guarantee promises a gross heat rate at rated load of 23,300 btu per gross kwh at the generator terminals.

Factory tests at Schenectady, New York showed a heat rate of 21,200 btu per gross kwh at 4000 kw load and a rate of 19,680 btu per gross kwh at 4900 kw load. The results quoted above are corrected to an 80 F ambient temperature and standard barometric pressure at 1860 feet msl, the elevation of the Williston station.

A five hour and forty minute test at the plant determined the gross heat rate on natural gas fuel was 19,300 btu per gross kwh. This test was conducted with a 4000 kw load at an average air inlet temperature of 32 F and an average barometer of 27.45 in. Hg.

Fuel burning schedules and startup tests have been so arranged that plant forces have gained considerable experience in changing the gas turbines from fuel oil to natural gas, and the

reverse. This change is not difficult and is readily accomplished in six working hours. With additional manpower, it could probably be accomplished in four hours.

Gas-to-oil fuel changeover requires that the fuel nozzles within the combustors be changed, the shaft-driven atomizing air compressor must be bolted to the accessory drive case at the governor end of the turbine and the gas fuel regulating valve must be removed and replaced by an oil pump. Flexible connectors are so arranged that when oil fuel is used, the gas fuel manifold becomes the atomizing air supply to the burner nozzles.

Recently, both gas turbines were completely disassembled for inspection by factory supervisory personnel. All bearings, the reduction gears, burners, combustion liners and turbine blading were found to be in excellent condition. The compressor blading had a very light deposit on the first four stages of each unit, indicating good filter performance. Four compressor blades of the first unit were found slightly damaged, due to a foreign object passing through the first five stages. Indications were that this object was a very short piece of light welding rod which, although extreme caution had been exercised in cleaning and inspecting the inlet duct, evidently was overlooked. The damaged blades were replaced, even though considered still serviceable. Blading of the second unit's compressor section was found to be in perfect condition.

### Wheel Inspection

The gas turbine wheels of both units were subjected to red dye checks and sonic tests, with particular attention to the fusion weld which joins the austenitic wheel rims to the ferritic wheel spools or hubs. These tests indicated that the first stage wheel of one unit and both wheels of the other unit were in perfect condition. The second stage wheel of the first unit installed yielded evidence of minute voids in the fusion weld which the manufacturer wished to study. Although the wheel was considered serviceable, it was replaced, and the used wheel was returned to the factory for laboratory examination. The original blades of this wheel were continued in use.

Coincident with the inspection, some minor field modifications were made to eliminate some small oil leaks and leaks on the cooling air systems. These modifications were principally of a nature permitting greater freedom of parts to accommodate thermal expansion and contraction. In considering these changes, it should be noted that the Williston gas turbines undergo frequent start-up and shutdown sequences, and this type of service will make more acute difficulties due to thermal expansion and contraction experienced prior to completion of modifications. Experience subsequent to modifications has been most satisfactory.

It is well known that other gas turbine installations have successful service records totaling in excess of 30,000 hours of fired time per unit. Experience with the Williston installation is such that a long and successful service life, with reasonable fuel costs, low operating and maintenance costs, and excellent availability can be confidently predicted. The advantages of an initial investment as low as $175.00 per kw of capability are very attractive in increments of capacity below 20,000 kw, and such a low initial investment can justify a considerable premium for suitable liquid or gaseous fuels.

### Miscellaneous Data

Where standby considerations, or a limited cooling water supply, or an immediate need for capacity point toward the use of internal combustion engines, careful evaluation of the gas turbine will show that this form of generation can be advantageously applied to solve any or all of the problems noted.

Lubrication of the gas turbine units has been completely successful using Socony Vacuum DTE-797. This is the same oil as is used in the steam turbine at the plant, so oil inventories have not been complicated by the new equipment.

The main forced oil lube system supplies the entire chain of bearings in the gas turbine generator unit, including the tailshaft exciter. The cranking motor alone is separately ring oiled.

All bearings are equipped with iron constantin thermocouples embedded in the bearing babbitt. Maximum temperatures are generally recorded at the reduction gear bearings rather than at the bearings nearest the high temperature shafting and gas turbine wheels.

Each gas turbine has a 1000-gallon lube oil tank and three oil pumps. A 15-hp ac electric pump supplies oil for normal startup and shutdown and operates only at those speeds below which the main lube oil pump, which is shaft driven, is ineffective. A 3-hp dc pump, wired to the station battery, serves in event of an emergency shutdown attended by total ac power failure. Each unit has a conventional oil cooler similar to those in steam turbine practice.

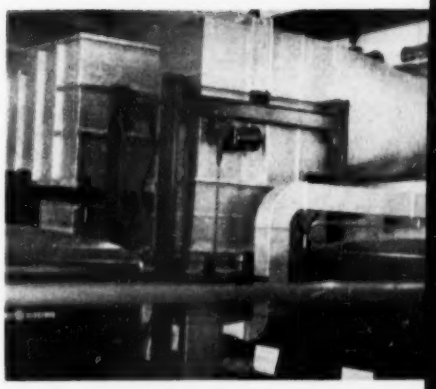


Fig. 4. Air intake and exhaust ducts. Exhaust duct (center) is supported from a rigid frame by constant-support hangers

### Manpower

Experience at Williston indicates that gas turbine operating manpower requirements are well below those of the usual steam installations of similar size. *One additional man per operating shift can attend all readings and adjustments to the cooling water and fuel supply systems*, and this man can still attend some routine operating and maintenance matters connected with the steam plant. The gas turbines are characteristically cleaner and reciprocating internal combustion engines and the plant can be kept perfectly clean with little labor.

To date, it has not been necessary to clean and recharge the air filters, but under dusty conditions during continuous operation, cleaning can proceed on a continuous basis, replacing a few cleaned filter cells at a time. This should not increase manpower requirements.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# Heater Drain Pumps Face Tougher Steam Conditions

BY T. W. EDWARDS*

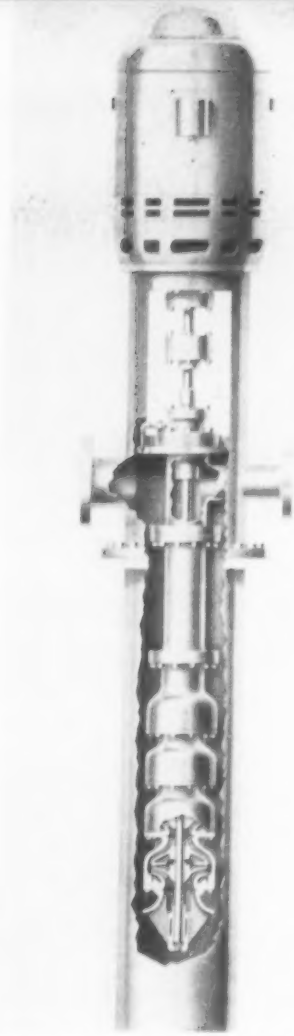


Fig. 1. Can-pump. Consists of standard vertical pump fitted into steel can

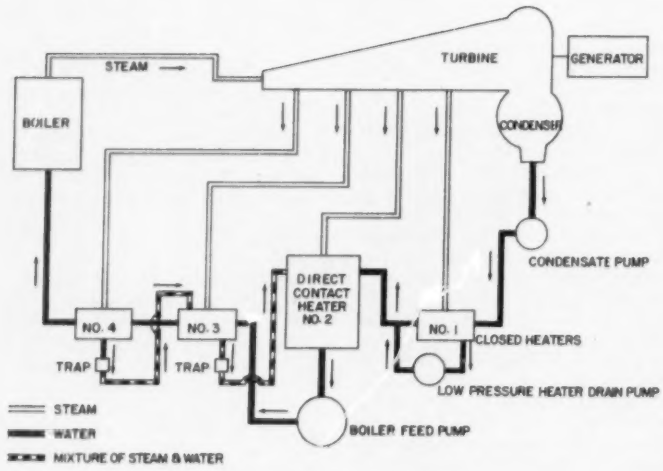



Fig. 2. Diagram illustrating typical cycles for a boiler feedwater heating system

**Present trend for heater drain pumps to discharge at higher pressures makes their correct application increasingly important. Features of these pumps for high pressure duty are discussed here**

IN ORDER TO IMPROVE thermal efficiencies, modern steam-electric stations employ a wide variety of feedwater heaters to pre-heat boiler feedwater prior to its introduction into the main steam generator. As explained in the May and July 1954 issues of POWER ENGINEERING, heat for the operation of these feedwater heaters is derived from steam extracted from the main turbine. While in the case of an open deaerating heater this steam condenses and passes out with the feedwater, in a closed heater, where steam and feedwater do not mix intimately. This condensate must be dealt with separately.

In general, there are two methods of handling these heater drains. They may be cascaded or flashed to a lower pressure point in the cycle, as in the case of heaters 3 and 4 in Fig. 2; or they may be pumped to a higher pressure point in the feedwater cycle, as in the case of heater 1 in Fig. 2. It is this latter and rather specialized pumping application that will be discussed in this article. The various types of hydraulic systems against which these heater-drain pumps must operate has been discussed previously,[1] so this article will be confined to some of the physical aspects of the pumping equipment involved.

Since the trend in some modern steam-electric station designs appears to be towards the use of heater drain pumps serving higher and higher pressure feedwater heaters, as opposed to cascading or flashing these heaters, the correct application of heater drain pumps becomes more and more important. As the percentage of station auxiliary horsepower consumed by heater drain pumps increases, their importance and the attention paid to them by station designers and operators will increase and approach that accorded the main boiler-feed pumps.

Two general arrangements of pumping equipment prevail in heater drain pump applications. Horizontal pumps are normally to be preferred because of ease in operation and maintenance; however, low available Net Positive Suction Heads (NPSH) often preclude their use. Under these conditions, vertical "can-type" pumps are frequently employed. With this type of pump almost any required NPSH can be made available by merely increasing the depth of the can and thereby lowering the first stage impeller.

In either arrangement, high suction temperatures and pressures are frequently encountered. For this reason, it is often found necessary to use equipment specifically designed for these severe operating conditions. This type of centrifugal pump is normally provided with water-cooled bearings and stuffing boxes and other necessary specialized features.

Figs. 3, 4, & 5 show various horizontal pump types which may be employed as heater drain pumps. The single stage unit shown in Fig. 3 is used where total heads to be developed are relatively low. Heavy casing sections are provided for high pressures.

For high operating temperatures, water-cooled bearings and stuffing boxes are used. This general type is

[1] See Power Engineering May 1954, Page 78 (Part I); July '54, p. 66, Power Engineering (Part II)

* Application Engineer, Worthington Corporation.

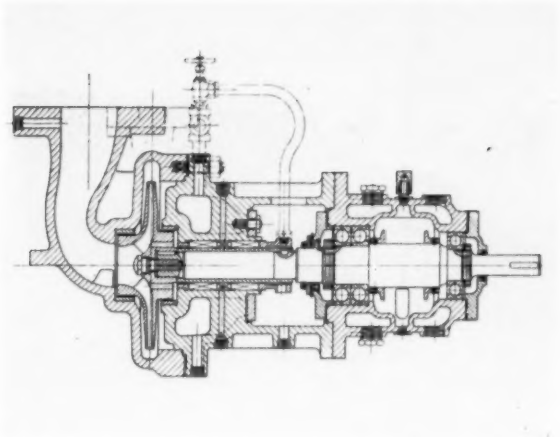


Fig. 3. Single stage heater drain pump used for low heads. Heavy casing sections are provided for high pressure systems

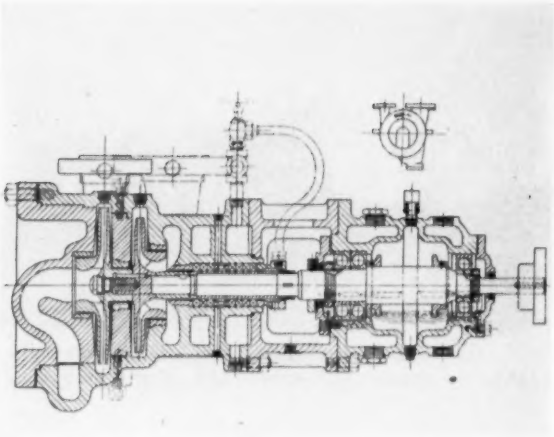


Fig. 4. For high temperatures, water cooled bearings and stuffing boxes are used, with heavy casings for high pressures

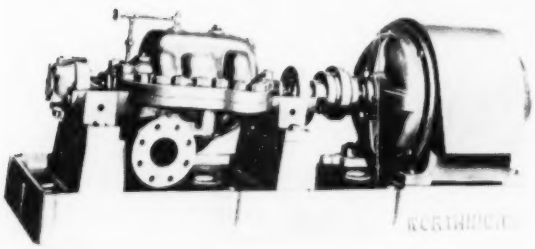


Fig. 5. Where more than two stages are needed to produce required pressure, standard boiler feed pumps are often used

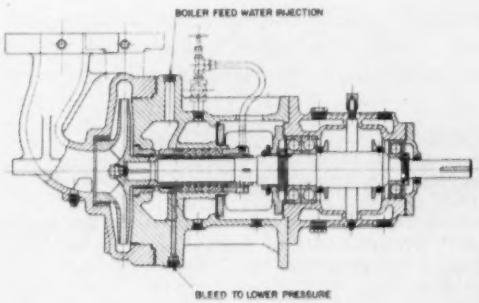



Fig. 6. For high pressures and temperatures, packing temp is limited by special condensate-cooled breakdown bushing

also available as a two-stage pump where heads are beyond the range of a single stage. See Fig. 4.

Where more than two stages are necessary to produce the required developed head, boiler feed pump types are frequently used, such as shown in Fig 5.

Where the combination of high system pressures and temperatures precludes the use of standard stuffing box arrangements, special provisions must be made. Fig. 6 is a cross section of a single stage pump, similar in design to Fig. 3, but with the addition of a special breakdown bushing ahead of the stuffing box to limit the temperature against which the pump must be packed. Relatively cool condensate at a pressure exceeding pump suction pressure is introduced at this bushing and flows along the shaft both into the pump and towards the packing, thereby excluding excessively high temperature water from the packing. Excess condensate is bled off to some lower pressure point in the system.

As previously mentioned, low available NPSH conditions can exist especially where these closed heaters are located at a low elevation. These conditions may be unsuitable for pumps of standard horizontal designs and may require can-type pumps. See Fig. 6.

Can-type pumps are also found desirable where available NPSH is just barely adequate for a horizontal design with no margin. In these borderline applications, a can-type pump will, of course, produce almost any desired margin of available over required NPSH. This margin, as well as being a factor of safety under stable operating conditions, reduces to a minimum the chances of flashing these heater drain pumps during periods of fluctuating station loads.

For normal low-pressure heater drain service, these can-pumps are usually adaptations of standard vertical turbine pump designs fitted into a steel can or suction well. Since usually no thrust bearing is incorporated in the pump itself, the motor thrust bearing must carry the additional thrust from the pump made up of the dead weight of the pump rotor and frequently the hydraulic thrust resulting from the differential head developed by the pump. Pump line bearings are lubricated by the water pumped, so that the drains will not become contaminated by the introduction of oil.

As suction pressures, temperatures, and total heads increase, modifications to standard designs become necessary. Additional stages must be used to develop higher heads. High discharge heads against which packing must operate in these vertical designs require the use of a breakdown bushing ahead of the stuffing box to limit the pressures against which the packing must operate. Where suction pressures are greater than atmospheric, these breakdown bushings may be bled to suction pressure. However, where pump suction is under a vacuum, it is often found desirable to bleed this bushing to some intermediate stage. In this manner, the pressure in the stuffing box can be controlled very closely. High temperatures require the use of water cooled stuffing boxes. Since hydraulic thrust is a direct function of developed *continued on page 106*

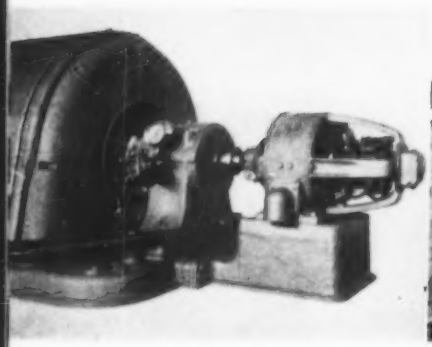


Fig. 1. Old-fashioned exciter with open housing was unprotected against dirt

Fig. 2. Later type than Fig. 1. Exciter uses same ventilating air as generator

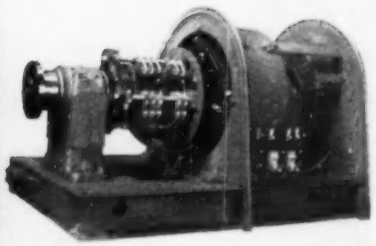


Fig. 3. Self-cooled exciter. The generator has separate ventilating system

# Exciter Ventilation Practice Today

BY L. M. DOMARETZKY*

**Remarkable reliability of modern turbine generators would be impossible without dependable auxiliaries. Here's how ventilation has improved the performance of exciters for medium sized generators**

NO GENERATOR can function any better than its excitation system. For example, performance of a 12500 kva turbine generator is critically dependent upon reliable service from a 50 kw exciter which is usually coupled to the generator shaft. One of the most important features in a reliable exciter is adequate ventilation. Exciters must have properly designed ventilation systems for two reasons. First, ample quantity of cooling air will reduce temperature of windings, core, and commutator, which in turn leads to long winding life and aids trouble-free commutation. Second, danger of shorted field coils and armature flashovers must be minimized by preventing accumulation of conducting particles on the field and armature windings.

Exciter ventilation circuits have taken various forms in the past. This article will describe some of these, and then discuss current trends in the design of ventilation circuits for exciters direct-connected to medium size air-cooled turbine generators.

### Early Types

Early direct-connected exciters, before about 1938, were of the completely open type, as shown in Fig. 1. There was no forced ventilation for either the exciter or the generator collector rings. Accessibility was excellent, but the exciters were vulnerable to damage from dirt.

In the late 1930's, exciters were enclosed in a housing which was interconnected with the generator ventilation circuit. Fig. 2 shows an exciter of this type. The generator collector rings are in the open. A later refinement was to extend the enclosure to cover the collector rings and bearing pedestal. Fig. 3 shows the complete ventilating arrangement. Air is led from the high-pressure side of the generator fan through a pipe to the collector enclosure, then through the exciter and an air filter to remove carbon dust, and finally back through another pipe to a low-pressure region in the entrance to the generator fan. Another variation of this scheme was to lead the warm air from the exciter to a point ahead of the air coolers so that it was cooled before entering the generator.

Most recent trend has been toward self-cooled exciters. In this type, a fan mounted on the exciter shaft circulates air through the exciter and collector enclosure completely independently of the generator. The generator ventilation circuit can thereby be made more nearly leakproof, minimizing deposits of dirt and carbon on the generator windings and prolonging their life. The purchaser is also spared the inconvenience of having to provide duct-work in his foundation to return air from the exciter to the generator. Air pressure within the exciter enclosure can be held within limits which will prevent oil leaks and foaming, which occasionally were troublesome on generator-cooled exciters.

The features of a modern self-cooled exciter can be seen in Figs. 4 and 5. The commutator is at the coupling end, with a centrifugal fan mounted on the outboard end of the exciter shaft. After leaving the fan, air is forced through the exciter frame, ventilating the armature and field windings, and then passes over the commutator. This arrangement has the advantage that brush dust from the commutator is carried outside the enclosure instead of being deposited on the exciter windings.

Generator collector rings are ventilated in parallel with the exciter by allowing a portion of air from the fan to pass through a duct in the cover to a point over the rings. After cooling the collector, this air then discharges through the same opening as the exciter air, carrying dust from the generator brushes with it.

### Air Filters

Air inlet and discharge openings are located below floor level, because this has been found to lower noise level in the turbine room. Air filters are provided at floor level at the outboard end of the enclosure to filter out most of the dirt particles in the inlet air. A convenient access opening in the end of the housing permits changing filters whenever they have picked up so much dirt as to become inefficient. It is recommended that filters be changed when they show twice the pressure drop of a clean filter.

In certain cases where the atmosphere is exceptionally dirty, additional measures may be required. For instance, the exciter ventilation circuit can be completely enclosed by installing a small air cooler inside the exciter housing. In this way clean air is recirculated through the exciter with very little dirty outside air entering as makeup. In this system air filters are also required to pick up carbon dust from the collector and exciter brushes, and prevent it from being carried around and deposited on the exciter windings. Other solutions are to bring clean air in through ducts from some remote

* Medium Steam Turbine, Generator and Gear Department, General Electric Co.

location, or to use one of the various types of dust-catching equipment such as electronic precipitators. In general, it is only the occasional industrial installation which will require additional equipment, while many industrial plants and almost all utility companies will find that the simpler system first described will be perfectly adequate.

Exciter and generator bearings are all located in regions of positive pressure with respect to atmosphere. This is a necessary condition, as bearings located in negative pressure regions may leak oil. It is also important to prevent excessive pressure around the bearings, as foaming of the oil may result. To hold the air pressure within required limits, fan characteristics must be carefully selected after consideration of exciter losses and air flow resistance.

Knowing the exciter and collector losses, the desired air flow is established so that the temperature of air passing over the commutator will not be too high. The exciter must then be designed so that the air pressure drop through the exciter is within allowable limits when the desired quantity of air is forced through it. This is usually easy to accomplish since the typical exciter frame is short relative to its diameter, and there are ample spaces for air passage between the field poles and commutating poles.

External appearance of a modern self-cooled exciter is shown in Fig. 6. The single-piece exciter and collector enclosure harmonizes with the appearance of the main turbine-generator set. Hinged panels on each side provide access to collector and commutator brushes, and to the bearings. The duct which carries air to the collector is located just under the top of the cover where it does not spoil the simple contour, but actually helps to strengthen the cover and to prevent vibration. At the end of the housing may be seen a small cover plate which may be removed to change air filters whenever necessary.

### Advantages

Summing up, then, the advantages of the self-cooled exciter are:

1. Ventilation circuit of the main generator can be made tighter, thus keeping generator windings cleaner and improving generator reliability.

2. Purchaser's foundation design is simplified since exciter air circuit is not connected to generator.

3. Oil leakage or foaming at bearings is minimized through proper control of air pressure around bearings.

4. Brush dust is carried out of the housing and not deposited on exciter windings.

As the advantages of self-cooled exciters are more generally appreciated, they will be supplied on increasing numbers of medium size air-cooled turbine generator sets in the near future.

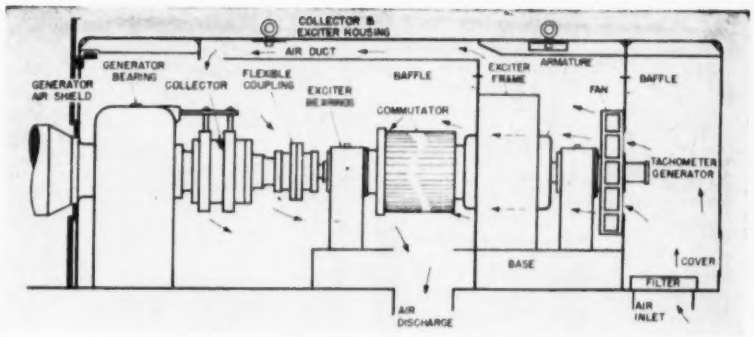



Fig. 4. Diagram of exciter ventilation. Note that once air has passed over commutator it is discharged, so that carbon dust is kept away from the windings

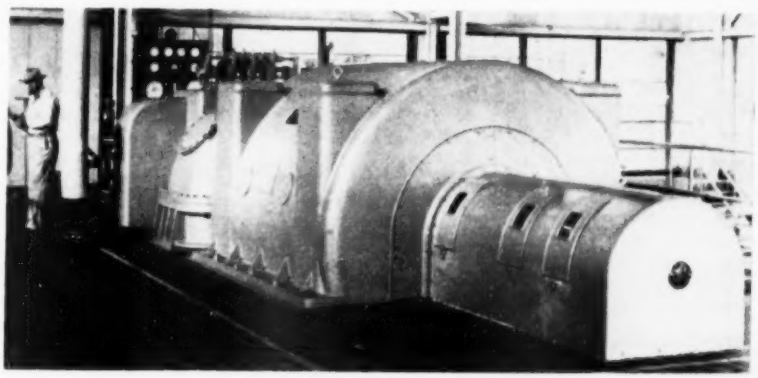


Fig. 5. A modern turbine generator showing housing over the self-cooled exciter

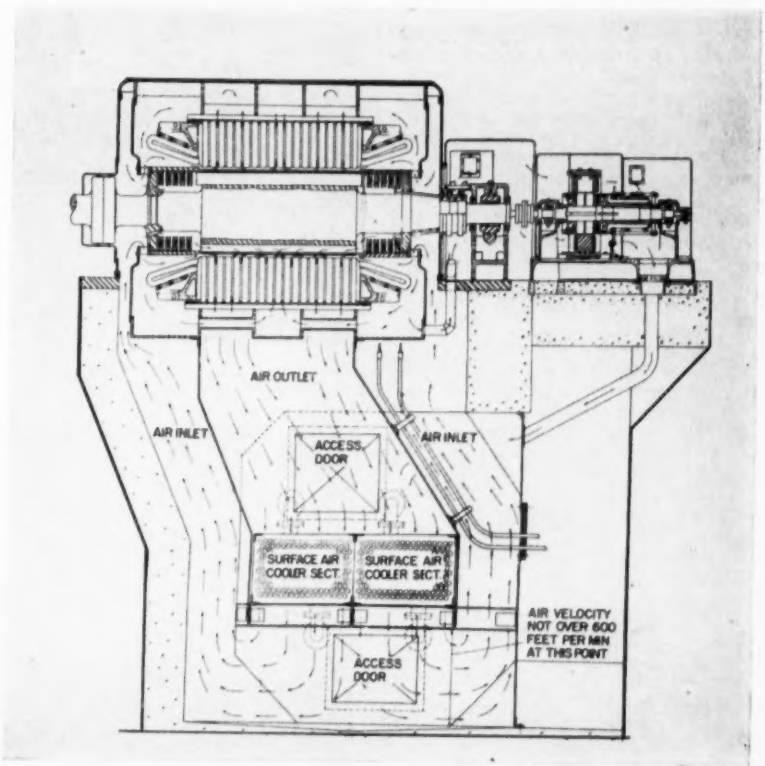



Fig. 6. Section through a modern generating unit, showing air cooling and recirculating arrangements for cooling the generator, exciter and collector rings

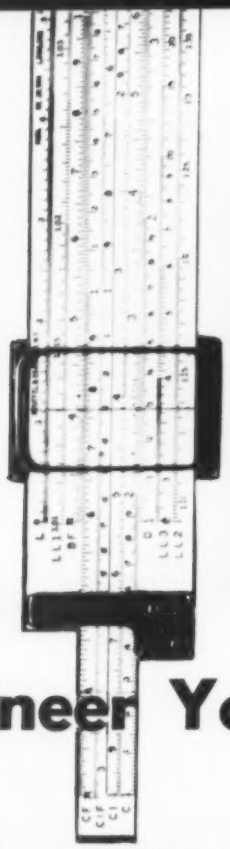


Fig. 1. Chief concern of the engineer is 'k'-value of insulation, not thickness

# Engineer Your Duct Insulation

**If you are concerned about providing the most effective insulation for your air duct system, stop worrying. Here are practical engineering principles to help you achieve real efficiency**

By S. J. STACHELEK *

THE OLD HIT-OR-MISS approach to the insulation of ducts carrying heated or cooled conditioned air is being superseded by a growing appreciation of the desirability of *engineering* duct insulation. The engineering aspects of duct insulation certainly have received increasing recognition in recent years because more technically trained men are becoming associated with the field; these men realize that engineering the insulation for an air duct system is as important as engineering the design of insulation for pipe lines, and for much the same reasons.

Specifically, insulation design for ducts in air conditioning and forced warm air heating systems is affected by three considerations: (1) heat saving — the reduction of waste from heat gain or loss in the system, (2) protection against condensation — the prevention of possibly serious moisture damage to building structure or equipment, and (3) sound control — the prevention of excess noise transmission to areas where the maintenance of low sound levels is a requirement.

Each of these three factors represent a separate and distinct design problem requiring separate methods of solution, but for most general purposes the application of the principles discussed in this article will aid the practical engineer to achieve satisfactory results.

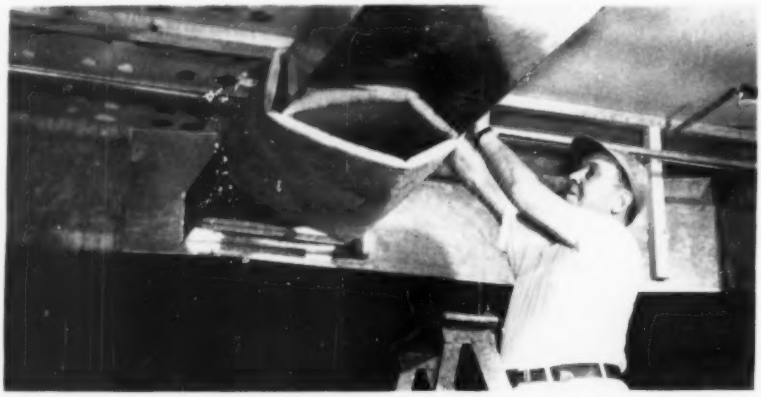


Fig. 2. Flexible insulation offers low-cost installation, fits any duct shape

Fig. 3. All joints, fasteners, require sealing with vapor impermeable compounds

*Engineer, Owens-Corning Fiberglas Corp.

In designing an air heating or cooling system, the engineer first calculates the amount of heat or cold that must be supplied through the system to meet the requirements of the areas to be conditioned. Added to the total so derived is the sum of losses or gains due to waste in the supply lines or return ducts. It is at this point that the engineer should begin consideration of insulation, because prevention of waste due to duct losses means smaller equipment, with a consequent saving in initial installation cost and reduced operating expense.

### Heat Saving

A simplified approach to insulation requirements is given here; it will, however, be adequate for most general purposes. Desired size of equipment based on total room heat losses or gains, without waste, provides a clue to the losses to be permitted in the duct system. On the average, an uninsulated sheet-metal duct will have a heat transmission rate (air to air) of 1.3 Btu per hr, per sq ft of duct surface, per degree F temperature difference between inside and outside air. This is designated as the *U-value* of the duct, U being a coefficient of heat transmission consisting of the values expressed above. Most installations justify an efficiency of 80 per cent or better, meaning that insulated U-value should be based on a maximum heat transmission of 0.26 Btu per hr.

Insulating materials are rated in thermal conductivity values, known as *k-values*, which are a rating of Btu passage through a one-inch thickness of the material, per hr, per sq ft surface, per degree F difference. By converting the k-value (thermal conductivity) to its reciprocal, thermal resistivity per inch, the required thickness of insulation is readily calculated; the only formula that this calculation requires is really a definition of U-value:

$$U = \frac{1}{R_t} \quad \text{or} \quad U = \frac{1}{R_{ins}} + \frac{1}{f}$$

where:

- $R_t$ = total thermal resistance
- $R_{ins}$ = resistance of insulation only
- $f$ = air film conductance (averages approx. 1.6 indoors, 6.0 outdoors. Air film coefficient inside duct omitted as negligible)

Typical U-values for insulated ducts with an insulating material having a k-value of 0.25 are given in Table I.

Quite often the engineer needs to know, or decides to use, a specific temperature at which conditioned air will enter each area. Thus the temperature rise of air passing through the duct becomes the criterion of insulation thickness. The following formula is used to determine the temperature of the air leaving a duct system:

Exit air temperature =

$$\frac{T_a(y-1)+2T_s}{y+1}$$

where:

- $T_a$ = temperature of air entering duct system
- $T_s$ = temperature of ambient air around duct system
- $y$ = $\frac{2.16\ CFM}{UPL}$
- CFM = cubic feet of air per min supplied by duct
- P = perimeter of duct in ft (make separate calculations for each length if duct varies)
- L = length of duct in ft

### Protection Against Condensation

The selection of insulation for protection against moisture condensation requires a different set of calculations. Here, the first step is to determine the dew point of the air surrounding the duct; this must be checked before any consideration can be given to insulation thickness and the type of vapor barrier protection to be employed. Dew-point temperatures can be determined easily if air temperature and relative humidity are known. Apply these factors to a vapor pressure table, or to a psychrometric chart such as that provided with the *ASH&VE Guide*. With dew point temperature determined, insulation thickness can be designed so that the temperature of its outside surface (to be treated with a vapor barrier) will be above the dew-point temperatures of the air, and thus prevent condensation.

Insulation thickness can be determined theoretically by use of the following formula:

$$T_s = T_o - \left[0.83U(T_o - T_i)\right]$$

where:

- $T_s$ = insulation surface temperature set as dew-point temperature
- 0.83 = critical air film resistance on top surface of cold duct
- $T_o$, $T_i$ = outside and inside temperatures of the duct

If the above equation is solved for U, the exact amount of insulation properties required to give the duct proper protection can be determined. This equation can also be converted to give an answer directly in inches of insulation required if insulating material with a k-value of 0.25 (such as is provided by several Fiberglas applications) is selected:

Minimum required thickness =

$$\left[\frac{-0.83(T_o - T_i)}{T_s - T_o}\right] \quad 0.83 \quad \frac{}{4}$$

Provision of a vapor barrier is imperative since most duct insulating materials are vapor porous, and those which are not need such protection at all joints and at points where fasteners are located. By definition, no material can be considered a vapor barrier unless it has a vapor permeability of less than one grain of moisture per hr, per sq ft, per inch of

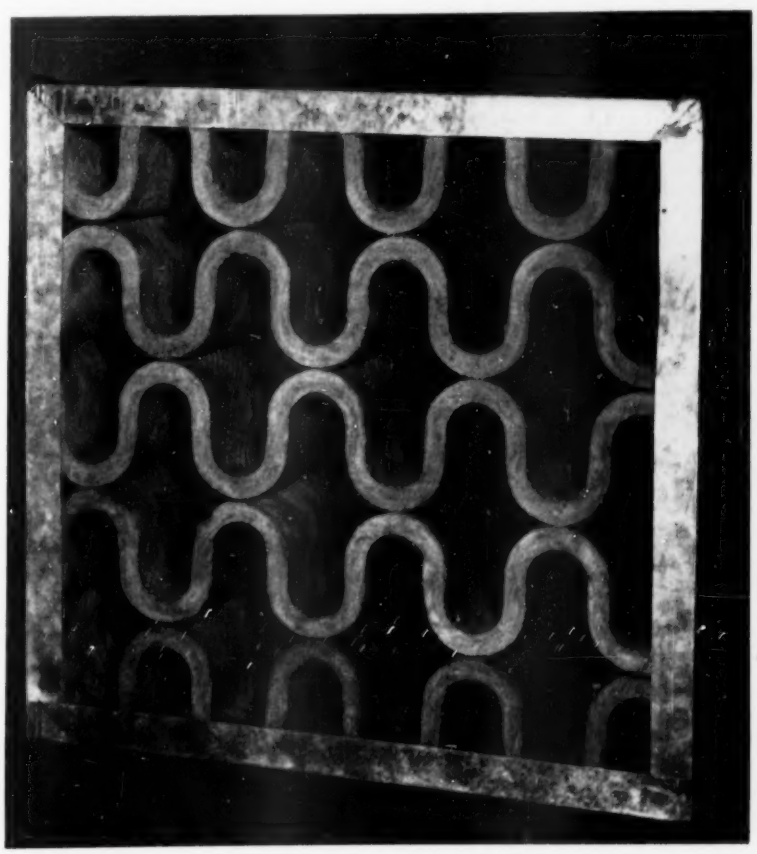


Fig. 4. Sound absorber cell inside duct provides good inexpensive noise control

mercury pressure difference. These specifications define a unit called a *perm*.

Very few air conditioning ducts can justify insulation without a vapor barrier finish. The major reason for such surface treatment is, of course, to prevent duct sweating and damaging moisture drips. However, the problem of heat gain or insulating efficiency is often overlooked in this connection.

Moisture within insulation adds to heat gain in two ways: first, by giving off heat when it condenses on the duct surface, and second, by wetting the insulation and rendering it less efficient. A further undesirable condition is the possibility of structural failures induced by the added weight of water-soaked insulation.

Several rules-of-thumb can be useful in specifying vapor barrier requirements. These are often based on specific operating temperatures for each area of the country. For example, where a 95 F dry-bulb temperature and a 73 F wet-bulb temperature are commonly used for design, the following minimum duct air temperatures should apply without a vapor barrier finish over insulation: ducts passing through normal, non-conditioned spaces, 65 F; ducts through spaces conditioned to 80 F and 50 per cent RH, 55 F. A safer general rule would be the specification of a vapor seal over insulation on all equipment operating at more than 5 degrees *under* local design dew-point temperatures.

Theoretically, vapor barriers for air conditioning ducts should be perfect, or have zero permeability. In practice, the attainment of perfection is often impractical and expensive and some compromise must be made. This is justifiable since most air conditioning systems seldom operate all year around and "reverse flow," or drying-out periods, will maintain insulation in a satisfactorily dry state of efficiency. For specifying the relative excellency of vapor barriers (in perms) under normal operating conditions, the values given in Table II will be useful.

Most commercial vapor barriers, whether papers, felts, or foils — or insulations with any of these integral with their construction — have advertised values of permeability and may be specified safely. Many insulation surfaces that are not in themselves good vapor barriers can be finished with prepared mastics or paints and thus be converted into suitable barriers. Good vapor barriers are also made better by this method. Typical examples of such finishes are listed in Table III.

Duct liners, or insulating materials designed especially for application to the interior of ducts, are a growing trend in the insulation of air conditioning ducts. With the insulation on the inside of the duct, the sheet metal itself acts as the vapor barrier (and a more excellent one would be hard to find) resulting in economies of maintenance, and often in initial cost. When utilizing this type of insulation, the engineer must consider the larger duct dimensions required and the added resistance to air flow that most of these ducts offer.

**Table I. Typical U-values for insulated ducts having insulation k-value of 0.25**

| Insulation Thickness | U-value |
|---|---|
| ¾ in. | 0.28 |
| 1 in. | 0.22 |
| 1½ in. | 0.15 |
| 2 in. | 0.12 |

**Table II. Desirable values of vapor permeability for normal conditions (perms)**

| Ambient Air Conditions | Operation Per Year 3 mos | 6 mos | 9 mos |
|---|---|---|---|
| Unconditioned (95F @ 75% RH) | 0.5 | 0.3 | 0.2 |
| Conditioned (80F @ 50% RH) | 1.0 | 0.7 | 0.5 |

**Table III. Surfacing materials that can be used to add vapor barrier protection**

| | |
|---|---|
| Oil-base, plastic, or rubber-base paints | Two coats over sizing can give permeability of 0.5 perms or better even over 4-oz canvas |
| Cut-back asphalt mastics | At ⅛-in. dry thickness, these average approx. 0.5 perms |
| Laggings adhesives such as Arabol, Lagfas, Swift's | Vinyl-base finishes like these build up good vapor barrier in themselves. Good also as white finishes over asphalt-base barriers |

## Sound Control

For the purpose of this discussion, mention of some of the design criteria used in this field will be sufficient. The basic measuring unit of sound is the *decibel* (db). One db is just barely audible to the normal human ear, and 120 db is loud enough to cause pain. "Silent" ducts are those which do not add to a noise level in an area, and thus must be on a register level slightly less than that which prevails in the area. Acoustical treatment is desirable, then, only when it is necessary to absorb noise in excess of that which prevails in an area.

Fig. 5. Internal liners good for year-round, hot or cold ducts; absorb noise

A noise reduction of 3 db means a theoretical 50-per cent reduction in sound energy or intensity of the noise. The human ear, however, needs a 3 to 11 db reduction (depending on original noise level) to make the sound appear to be half as loud. This is called the *apparent loudness reduction*. Except in special cases, good design calls for a reduction of 10 to 20 db.

When a sound absorbent material is installed on the interior surface of a duct, it will not only serve to absorb sounds originating in the system but will also usually act as the thermal insulating material when that is required.

Many rules-of-thumb are used when duct liner materials are employed to reduce sound levels. These apply chiefly when only a part of the duct is to be insulated. One of the rules states that a length of the duct equivalent to ten times the average diameter of the duct should be lined for generally satisfactory results; however, this same rule has also been quoted as from one-half to as much as one and one-half times that amount. A more accurate calculation for sound absorption is the following formula:

$$R = 12.6L \frac{P}{A} a^{1.4}$$

where:

R = attenuation, db
L = length of duct to be lined, ft
P = perimeter of duct, in.
A = cross-sectional area of duct, sq in.
a = absorption coefficient of liner. Use Noise Reduction Coefficient (NRC) published by liner manufacturers for average values, or the absorption coefficient at specific frequencies for elimination of a specific sound. Table IV, with interpolation, is sufficiently accurate for most design work.

As noted earlier, these calculations can be eliminated by the installation of a duct liner material throughout the duct system, which would not only serve as a better sound absorbing system but would also meet the thermal insulation requirements — and, in addition, will often do this at a saving in over-all cost.

**Table IV. Values of $a^{1.4}$ for nine different values of a, the absorption coefficient**

| a | 0.10 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 |
|---|---|---|---|---|---|---|---|---|---|
| $a^{1.4}$ | 0.04 | 0.11 | 0.19 | 0.28 | 0.38 | 0.49 | 0.60 | 0.73 | 0.86 |

View of portion of vast Commercial Museum, Philadelphia, where 21st National Power Show will be held December 2 to 7

# Special Events Planned for 1954 Power Show

SERIES of special events is being planned in conjunction with the 21st National Exposition of Power and Mechanical Engineering at Philadelphia, December 2 to 7, 1954. On the program will be papers and discussions of interest to visiting engineers including those attending the annual meeting in New York of the American Society of Mechanical Engineers, under whose auspices the exposition in Philadelphia's Commercial Museum will be held.

### Trips and Dinners

Of particular interest to ASME members will be plans now being developed for an inspection trip from the Annual Meeting in New York to the Power Show via the Fairless Works of U. S. Steel Corp. on Friday, December 3. On Monday, December 6, there will be a joint meeting of the Philadelphia Chapters of the ASME and the ASCE at Convention Hall.

Another timely event will be an all-day symposium on Automation to be held by the Instrument Society of America, December 3, covering such topics as: Trends; New Problems Created by Automation; Automatic Intelligence Gathering Systems; and an analysis of The Engineering Control Loop. Another event already announced is a dinner meeting of the Plant Engineers Club of Greater Philadelphia, to be held at the show Thursday, December 2.

Special bus service during the show will be operated from the Benjamin Franklin Hotel, with stops at other hotels along the way — round trip fare 50 cents.

A fast-growing list of exhibits scheduled for first showing at the exposition accumulated during the summer, as manufacturers completed arrangements for their displays. A sampling of specifications for "first-time" exhibits includes: a mastermind which records and regulates operating performances at many points in plant operation; an electric boiler of British origin; and a new exhibit illustrating seamless manufacture of steel pipe and tubes.

Displayed with the Autolog will be a supersensitive gas detector, designed to make possible accurate sensing of toxic or combustible gases in concentrations as extremely low as five parts per billion.

Model gas turbines, a cut-away steam turbine, a new line of electric motors, a line of fans and blowers, as well as unit heaters, will be shown by another well-known manufacturer.

Television for the power plant will be demonstrated, to show how a central control supervisor can observe such factors as furnace conditions, smoke, water level, remote gage dials. Instruments for measuring noise, devices for voltage regulation, and speed controls for small motors will be shown.

### Steam Dominates Show

Steam equipment dominates the show. The visitor will see an impressive array of packaged steam generators. There will be a new mechanically-sealed boiler feed pump designed to be capable of running dry for as much as 2 hours. Largest steam traps ever built and new lines of pressure reducing valves will be displayed.

An unusual new air-engine hydraulic pump, designed to operate on shop air line pressure, will be introduced. A liquid dust control system will be shown.

New piping and fittings for high-pressure, high-temperature work, and precision-drawn tubing will be exhibited.

In the water-handling field will be a new wet chlorinator, methods for controlling slime in industrial waters, feeding and weighing of dry solids and a new dual orifice meter.

### Safety and Electrical Equipment

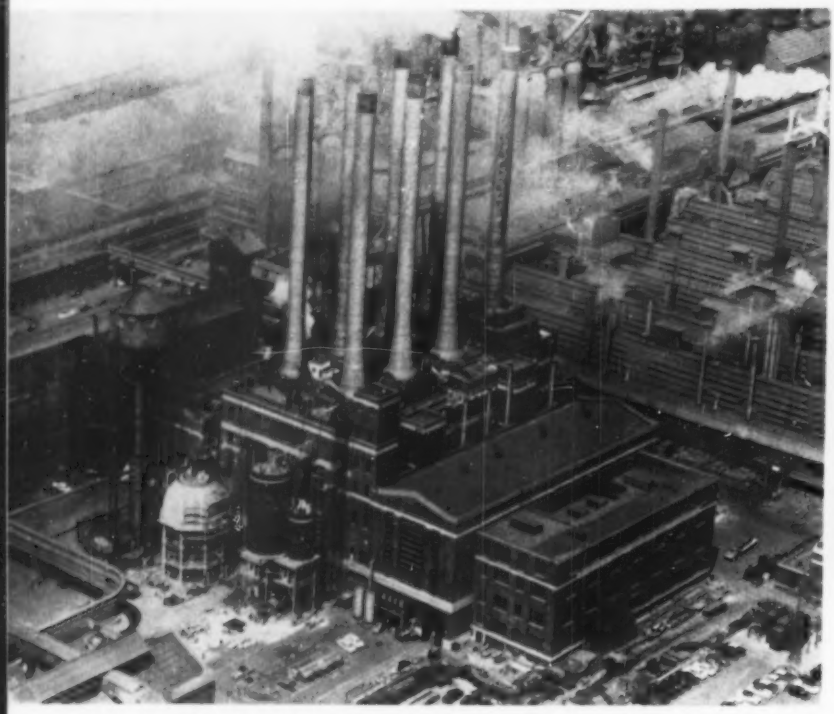
Safety equipment will include new high-voltage d-c insulation test sets; static control systems for neutralizing static charges in industrial processes, with alarm systems. Series of newly-developed plug-in control centers for industrial power distribution will be introduced.

From an English source will come the first U. S. exhibit of a line of high grade electric motors, built to NEMA as well as British standards. Several new automatic variable-speed electric motor drives will be exhibited, at least two of which employ pneumatic means of regulation.

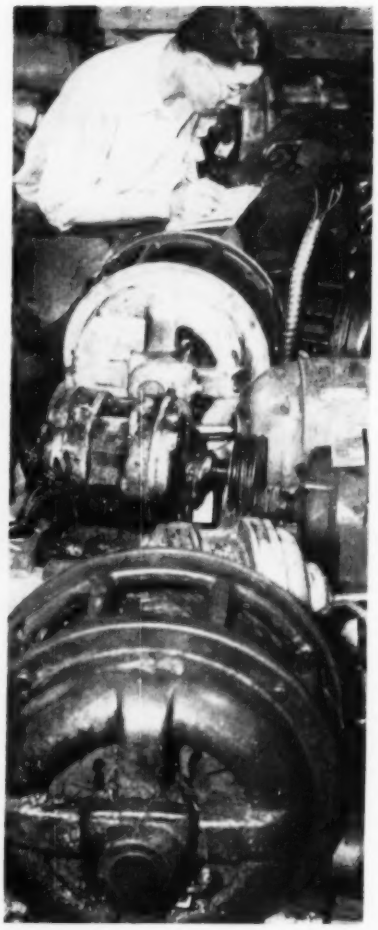
As heretofore, the exposition will be under the management of the International Exposition Co., with headquarters at 480 Lexington Avenue, New York 17, N. Y. President E. K. Stevens is manager of the exposition.

**For a free ticket to the Power Show write the Editor.**

# News Reel

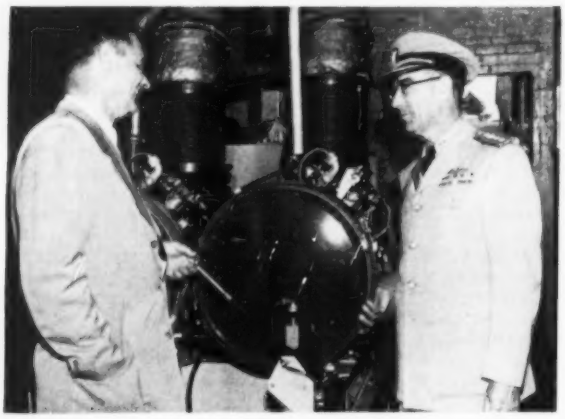


FORD MOTOR CO.'S Rouge Power Plant has the first of three new 250-psig, 650 F boilers on the line. Each will generate 600,000 lb per hr. The project, engineered by Kuljic ·, adds dust collection, fw heating and treatment facilities

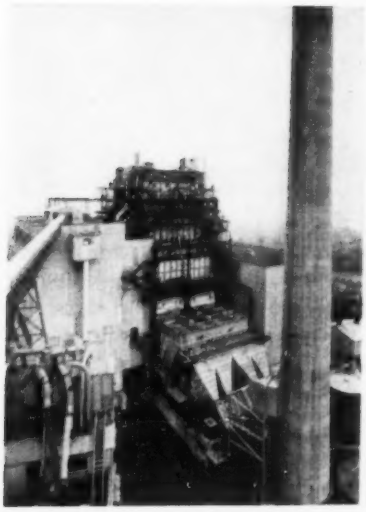


"CAROL", the misbehaving hurricane, left thousands of motors brine-soaked and damaged by corrosive salt spray. G.E.'s Boston Service Shop is shown here as a worker checks incoming motors, still coming in after more than 2,000 were repaired or in process. Sixty motor technicians were flown in

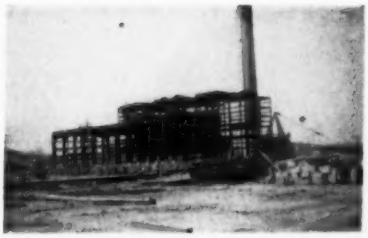
PACKARD MOTORS and the U. S. Navy have signed contracts to develop a mass-producible gas turbine ship propulsion plant. (From left) Commander Shallenberg, v-p Brodie and Lt. Cmdr. Fowden review plans for the new unit



BOEING'S new self-contained auxiliary power unit, composed of two 175-hp gas turbines, generates 200 kw and has new control system. Shown here are J. C. Anderson, of Boeing, and Rear Admiral W. D. Leggett, Jr., BuShips

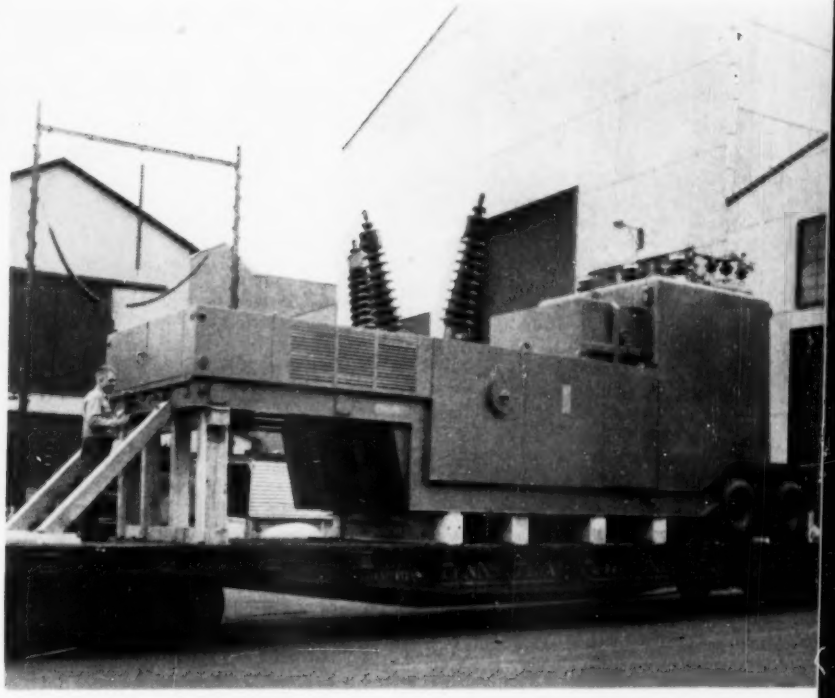


ELECTROSTATIC precipitators were installed recently in two new steam plants. (Top) Combined mechanical and Cottrell electrostatic unit went into Holtwood plant of Penn. Water & Power Company. A straight electrostatic (bottom) went into Meramec Station, Union Electric Company, St. Louis. Both were designed by the Research Corp.



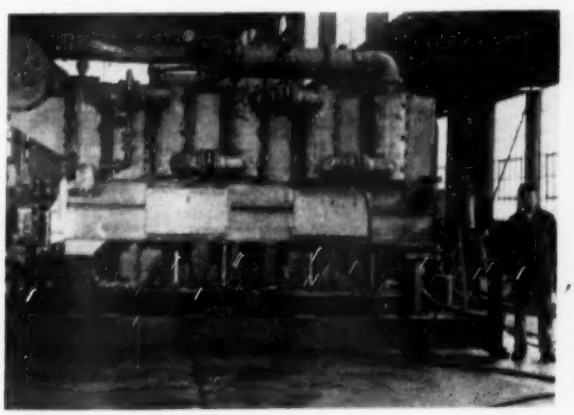
TVA'S John Sevier Station goes up near Rogersville, Tenn. Three 1050 F, 1800 psig, 180-mw units start up in '56

JOHN McKEAN, N. Y.'s new fireboat, pumps 14,000 gpm while towing a burning ship. Pumps are by Worthington



HIGHWAY MOBILE SUBSTATION takes its first ride on a flatcar. Three of these Westinghouse 5000-kva mobile units will be used by the Bureau of Reclamation for emergency power, or temporary power for construction sites, in the far West

STAND-IN STEAM PLANT will supply steam for hot water and heat in expansion area of Oceana Naval Air Station (Norfolk) until a new plant is completed in January. De-Bothezat Bifurcator fan provides needed induced draft



FLASH STILL for the production of fresh water from sea water has been completed by Griscom-Russell in cooperation with Bethlehem Steel. Believed to be the largest still of this type, it goes now to Bethlehem Quincy Yard for routine tests

# How the Power Department of

**Here is a specific, practical lubrication program worked out by the power department at Kodak Park Works of Eastman Kodak Co. at Rochester, New York. It shows types of lubricant used for each unit in power plant, how often used and inspected, how applied and by which operator. Program reduces number of lubricants stocked, gets right man for each job, prevents unscheduled outages of power equipment**

**By C. L. POPE* and C. R. O'NEILL****

THIS ARTICLE describes a lubrication program which has been in effect at the Kodak Park Works of the Eastman Kodak Co. for 25 years. Changes in the lubrication schedule are made to take advantage of improved lubricants, to meet the demands of new equipment or conditions of operation, as well as the result of operating experience.

The Power Department has two main steam and electric generating plants, two refrigeration plants, and a water pumping and purification plant located on Lake Ontario about 3 miles from the plant. Steam, air, electricity, refrigeration, and water are delivered to some 400 odd production and service departments over an area roughly ½ mile wide and 2 miles long. We employ about 22,000 people at this plant, and operate many of the departments on a continuous basis. Need for continuity of service justifies every safeguard that will insure uninterrupted service.

Necessary part of providing such continuity of service is the lubrication of all mechanical equipment under jurisdiction of the Power Department. Lubricants in Table I take care of every moving piece of equipment.

Steam is generated at 800 psi and 260 psi; and a 1400-psi boiler and turbine are now being installed. The first two pressures supply turbines coupled to generating units. Steam is extracted at 260 and 135 psi for steam-driven prime movers, 70 psi for processing, and 5-psi exhaust for heating and low pressure turbines. Normal load is 1,000,000 lb per hr of steam. There is a complete lubrication schedule for the boiler and auxiliary equipment. The abstract shown in Table II may be considered typical.

Figure 5 shows an air-pressure grease pump installed on a 400-lb grease drum that pumps grease through pipe from the operating floor up and alongside the coal conveyor. There is a quick-connect valve outlet about every 20 ft, so that the oiler can plug in about 15 ft of hose and lubricate the length of the conveyor without moving bulky equipment.

Temperature of 115 F is maintained on the oil leaving the cooler on direct-connected turbines, as a control point. This results in bearing oil temperatures of 130 to 160 F. Type 1150 oil is used. We have many uses for Type 1600 oil, which is more viscous than the conventional 300 SSU @ 100 F oil used for industrial geared turbines. Raising the temperature of the oil from 115 to 125 F from the cooler reduces the viscosity of the 500 SSU @ 100 F oil to that of a 300 SSU @ 100 F so that our geared units all operate with a heavier oil to eliminate the use of a 300 SSU @ 100 F turbine oil.

Centrifuges for each turbine are run while a turbine is in operation on a bypass system. Newer types of turbine oils separate so well from water that occasionally the overflow pipe on the side of the turbine loads up with a column of water, and all

Table I. These lubricants take care of all the moving equipment in the power department of the Kodak Park Works

**Rust & Oxidation Inhibited Turbine Oils**

Type 1150—a 150 SSU @ 100 F turbine oil
Type 1600—a 550 SSU @ 100 F turbine oil
Type 2120—a 115 SSU @ 210 F turbine oil

**Refrigeration Oil**

Type 1202—a 200 SSU @ 100 F non-additive low pour-point oil

**Air Compressor Cylinder Oil**

Type 1304—a 300 SSU @ 100 F non-additive turbine quality oil

**Steam Cylinder Oil**

Type 2165—a 160 SSU @ 210 F, 5% tallow compounded cylinder oil
Extra Heavy Cylinder Oil—a 220 SSU @ 210 F, 3% tallow compounded cylinder oil

**Greases**

EK B— a calcium soap, 280 worked penetration cup grease
EK M—a calcium sodium soap, 275 worked penetration ball and roller bearing grease
Lithium Soap—#2 Consistency
Coupling Lubricant—105 Saybolt Second Furol viscosity @ 210 F uncompounded oil

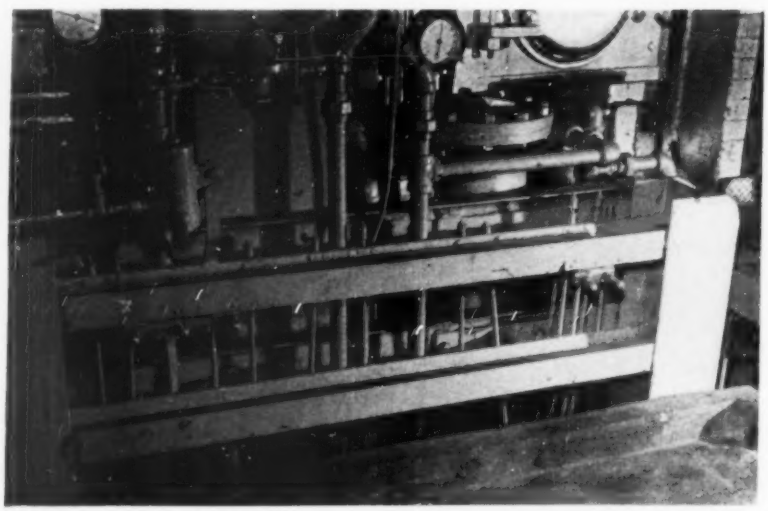


Fig. 1. In boiler house, convenient lubrication headers on underfeed stokers, connected by pipes to inaccessible bearings requiring lubrication under the stokers

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**Head of Maintenance Control Section, Utilities Division, Kodak Park Works — Eastman Kodak Co.

# E K Co. Programs Its Lubrication

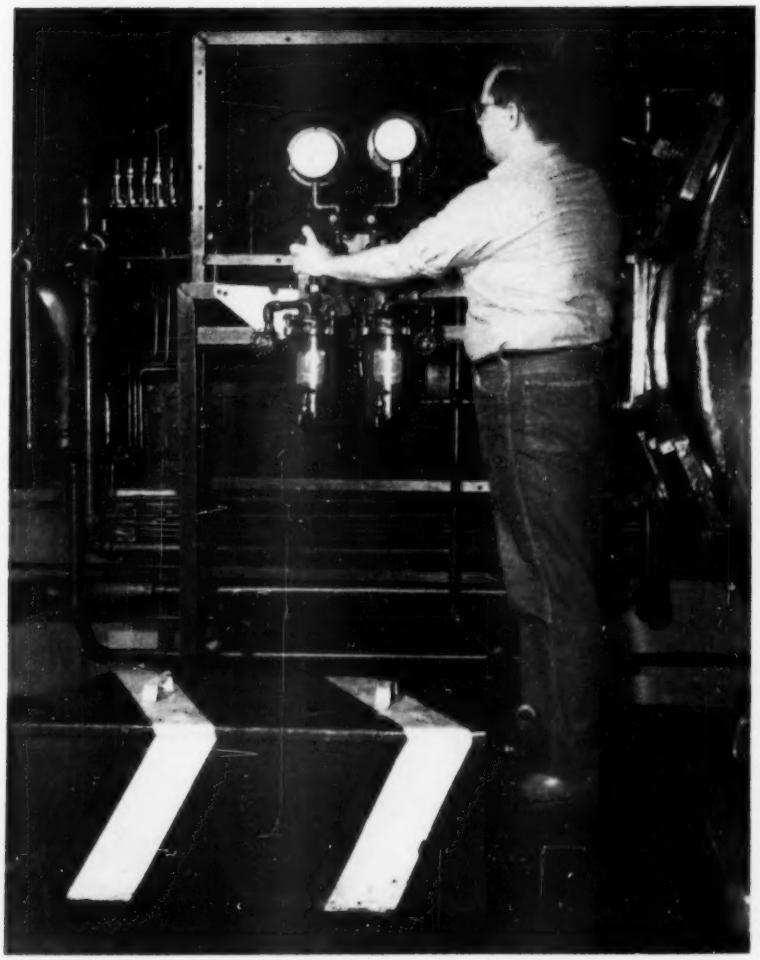


Fig. 2—Right. Operator adjusting lubrication on one of Kodak Park Works' two-stage air compressors, driven by reciprocating steam engine. This view shows oil tank and purifiers on the unit and force-feed lubricator in background

Fig. 3—Below. View of one of the steam-turbine-driven centrifugal refrigeration compressors, which the E K Co.'s Power Department must lubricate properly. For these units they use rust- and oxidation-inhibited oils; take oil samples monthly for analysis; base oil changes in systems on analysis results

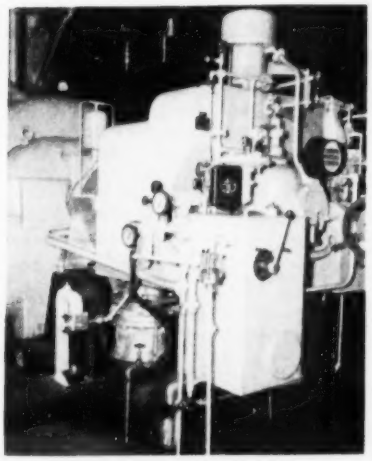


Fig. 4—Far Left. Alongside coal conveyor in power house runs a pipe line carrying lubricating grease supplied by pump shown in Fig. 5. This view shows how operator, using about 15 ft of hose (shown under his right hand) can plug into a quick-connect valve about every 20 ft on pressure grease pipe, and use gun along length of conveyor

Fig. 5—Right. This air-pressure grease pump, installed on 400-lb grease drum, pumps grease to pipe extending alongside coal conveyor so operator can lubricate conveniently, as in Fig. 4

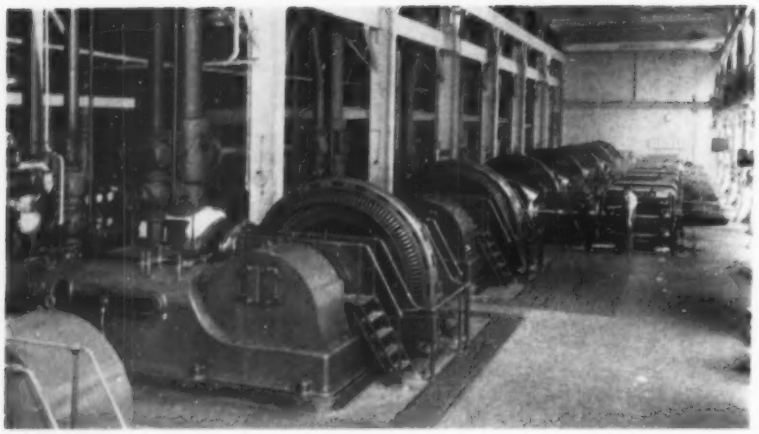


Fig. 6. This big battery of motor-driven and steam-engine driven ammonia compressors supplies refrigeration for the varied and extensive processes of the Kodak Park Works. Details of their lubrication programs are as given in the text

flow to the centrifuge ceases until the water is drained manually from the tank. Our new 12,500-kw turbine will have oil taken directly from the lowest point of the main oil tank to the centrifuge, to eliminate this difficulty and maintain our systems drier. Oil samples are taken monthly and tested for interfacial tension, acidity, water, and sediment. Twice a year, samples are procured and the Eastman Kodak accelerated oxidation test† is run to measure the effectiveness of the remaining oxidation inhibitor in the oil.

Experience has indicated that an oil which will last 300 hours in our oxidation test will give 11,000 hours of service in our most severe turbine. If a used oil should break down on test in less than 300 hours, we would change oil at the next most convenient time. No oils have broken down in turbine service due to resinous deposits since the introduction of the rust- and oxidation-inhibited turbine oils some 15 years ago.

External inspections are made yearly on turbines and internal inspections every three years. Rusting still occurs occasionally above the oil level and in some oil return lines where the surfaces are not well wetted by the oil. Turbines in intermittent operation so that excessive condensation occurs are most likely to show rusting. Painting with oil resistant paint above the oil level has practically eliminated rusting. Oil coolers remain so clean that they need only be inspected occasionally for examination of tube condition.

Governor camshaft gear bearings are lubricated the first Sunday each month with EK M grease. Dashpots, of course, are dependent upon viscosity, and ours require Type 2120 oil, inspected at 3-month intervals and the oil changed yearly.

### Air Compressors

Most of our air compressors are two-stage, steam-driven reciprocating engines delivering air at 90 psi. Type 1304 oil is supplied to the air cylinder by force-feed lubricators at a rate of approximately 1 gal of oil to 1,000,000 sq ft of area swept by the piston. Leads generally run to a quill on the suction side of each cylinder to take care of the intake valves and cylinder lubrication, and one lead to the packing of each rod. Valves are inspected once a year and piston rings are inspected every 3 years.

No deposits are found in the cylinders where intake filters clean the air and air discharge temperatures are approximately 250 F. Air-cooled type air compressors use Type 1600 oil containing the oxidation inhibitor. The common practice of locating the intake air filter at some distance from the compressor occasionally causes trouble from pipe scale and rust on the inside of the intake pipe entering

†Oxidation and Corrosion of Lubricating Oils, by C. L. Pope and D. A. Hall; *ASTM Bulletin* No. 121; March 1943.

Table II. Typical section of complete lubrication schedule for principal power house equipment in the great Kodak Park Works

| Part | Method of Lubrication | Lubricant | Inspect Every | Change lubricant or Lubricate |
|---|---|---|---|---|
| **Underfeed Stokers, Water-Tube Boiler** | | | | |
| Gear boxes | Splash | 2165 | Shift | Yearly by Field Division No. 9† |
| Turbine gear case | Splash | 1304 | Shift | Yearly by Field Division No. 9 |
| Linkgrate hyd. drive | Force feed | 1150 | Shift | Yearly by Field Division No. 9 |
| Main & conn. rod brgs. L.G. mechanism & ash discharge plate | Pressure Grease | EK M | 8–4 Shf. | H.P. boiler oper. |
| Stoker governor | Splash | 1150 | | Yearly by Field Division No. 9 |
| Windswept shift. valves | Pressure Grease | EK B | 4–12 Shf. | Tues. by boiler helper |
| Ash gates rollers | Pressure Grease | EK B | Month | Boiler room oiler |
| * Coal bunker gates | Pressure Grease | EK M | Year | Boiler room oiler |
| * Blow-off valves (stem brgs.) | Pressure Grease | EK B | Year | Boiler room oiler |
| Coal agitator brgs. | Pressure Grease | EK M | 8–4 Shf. | H. P. boiler oper. |
| **Turbine-Driven F-D and I-D Fans** | | | | |
| Turbine brgs. | Ring oiled | 1600 | Shift | Yearly by Field Division No. 9 |
| Fan brgs. | Ring oiled | 1304 | Shift | Yearly by Field Division No. 9 |
| Reduction gears | Force feed | 1600 | Shift | Yearly by Field Division No. 9 |
| Flexible coupling | Packed | | Year | Yearly by Field Division No. 9 |
| **Motor-Driven Boiler Feed Pump** | | | | |
| Motor brgs. | Ring oiled | 1304 | Shift | Yearly by Field Division No. 9 |
| Inboard pump brg. | Ring oiled | 1150 | Shift | 4/1 & 10/1 by Field Division No. 9 |
| Outboard pump brg. | Force feed | 1150 | Shift | 4/1 & 10/1 by Field Division No. 9 |
| Flexible coupling | Pack | Coupling compound | 6 mos. | 4/1 & 10/1 by Field Division No. 9 |
| **Coal Conveyors** | | | | |
| Drive gear brgs. | Grease cups | EK B | Day | Wkly. by Coal Eqt. Oiler |
| Corner wheel brgs. | Grease cups | EK B | Day | Wkly. by Coal Eqt. Oiler |
| Bucket wheel brgs. | Grease press. | EK B | Day | Wkly. by Coal Eqt. Oiler |
| 54″ drive gear | Bath | Coupling compound | Day | Wkly. by Coal Eqt. Oiler |

* To be done when boilers are out of service. † Field Division No. 9 is the maintenance division for power, has all tools, trades and experience to maintain equipment in their area.

the compressor, with consequent cylinder scoring and ring wear. It is worth while to locate the air filter in the suction line as close to the compressor as practical.

Type 1600 oil is used for crankcase lubrication. Steam cylinders on 136-psi 450-F steam are lubricated with Type 2165 oil and those on 260-psi 550-F steam are lubricated with the 220 SSU @ 210 F cylinder oil with 2 to 3 per cent compounding. We have never encountered any difficulty with steam-cylinder lubrication except the carburizing of the oil in the quills on the high-temperature steam cylinders. Routine inspection and cleaning of these quills is done every 6 months or 4000 hours of operation. Cross-compound piston-valve engines and duplex uniflow engines are in service.

### Ammonia Compressors

Ammonia compressors, motor and steam-engine driven, in the refrigeration plants use Type 1202 oil for crankcase ammonia cylinders and metallic piston rod packing lubrication. As a small amount of oil is carried into the ammonia cylinders on the piston rods, this oil must not congeal on the tubes of the brine cooler, which operate at −36 F. Oil purged from these brine coolers is reclaimed and used for lubrication of the steam-engine-driven ammonia compressors in the older refrigeration plant, which operates 9-F brine and 35-F chilled water coolers. The engine-driven compressors are operated with 135-psi 450-F steam and the steam cylinders are lubricated with Type 2165 oil.

### Centrifugal Compressors

Centrifugal refrigeration compressors are all steam-turbine-driven, direct-connected. About one half are driven with non-condensing turbines and the rest with condensing turbines. Turbines use Type 1150 oil and the compressors Type 1300 oil. Compressors originally operated on non-additive oils, but recently these have been replaced with rust and oxidation inhibited oils. Samples are taken monthly from each oiling system for analysis. Oil change on these units is based primarily on routine oil analysis.

Water pumping station uses a lithium soap, 265-295 penetration grease on all ball, roller, and plain bushings because of the universally wet condition of most of the equipment. Type 1300 oil is used in all inside gear reducers and ring-oiled bearings. On all outside gear reducers SAE 90 mild e.p. oil is used to accommodate the low ambient temperatures in the winter.

We should like to stress the fact that, by being sure the right types of lubricants are being used, by compromising to reduce the number of lubricants being used in any one area, by scheduling lubrication and inspections, and finally by having well-informed designated personnel to do the work, all unscheduled outage is avoided unless some very unusual and unforeseen case arises.

Fig. 7. View in the oil storage room of the power house at Kodak Park Works, showing modern practice in storing and handling lubricants for a power plant. Note oil storage tanks carefully labeled, also overhead hoist for handling drums

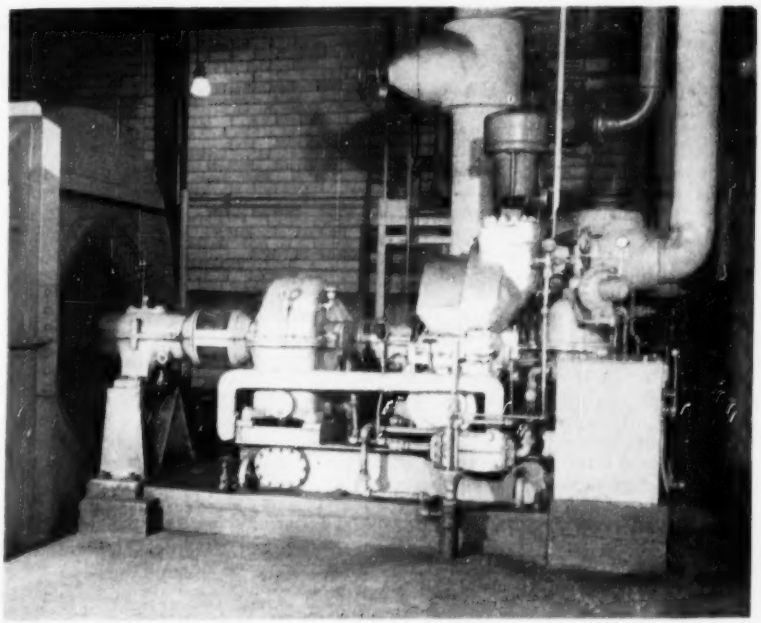


Fig. 8. One of steam-turbine-driven I-D fans in the Kodak Park power house

# Know Your Boiler Blowdown System

**This clear explanation of present-day practice tells you what you need to know about boiler blowdown; how you can improve your system; and how to use a simple method for sizing blowdown piping**

**BY FRANK M. KAMARCK***

PURPOSE OF a blowdown system is to provide a safe, convenient and legal means of draining or venting one or more portions of a steam-generating unit. Among the areas which require draining are: the boiler drum, pocketed water wall headers, economizers, bare tube boiler sections, superheaters, etc. Any modern steam-generating unit is provided with at least the following:

1. Continuous blowdown from steam drum
2. Superheater drains (or vents)
3. Lower header drains

A typical blowdown system is shown in Fig. 1. In addition to the minimum drains as outlined above, there are also shown drains from the economizer, boiler gage glass, safety valves, etc. It will be of interest to list each of the drains, discuss its purpose, and ascertain which of the drains dictates overall design of the system.

### Operating Instructions

In order to understand the boiler blowdown system, let us examine some typical operating instructions for a half-million lb per hr boiler.

Boiler should be blown down at least once every 24 hours, or more often if the feedwater is of inferior quality or the amount of make-up is large.

Use of the boiler bottom blow-off valves should be restricted to periods of moderate steaming rates and preferably very low combustion rates. The bottom blowdown should always be used to free a boiler of sediment when the boiler is being cut out.

Never make the blowdown long enough to lose sight of the water in the gage glass. Check the valves for leaks occasionally. Never blow down the water walls, waterscreens, etc., while the unit is steaming. These may be blown down when the unit is taken out of service.

If a superheater is installed with the boiler, before lighting-off it should be drained through lines free from back pressure and vented at the outlet to assure a flow of steam in order to protect the superheater elements from overheating. The superheater drains should then be closed with the exception of the superheater outlet drain, which must remain open until the boiler has gone on the line and is carrying load. This drain valve may be throttled somewhat when the boiler pressure becomes sufficient to assure considerable flow through the superheater.

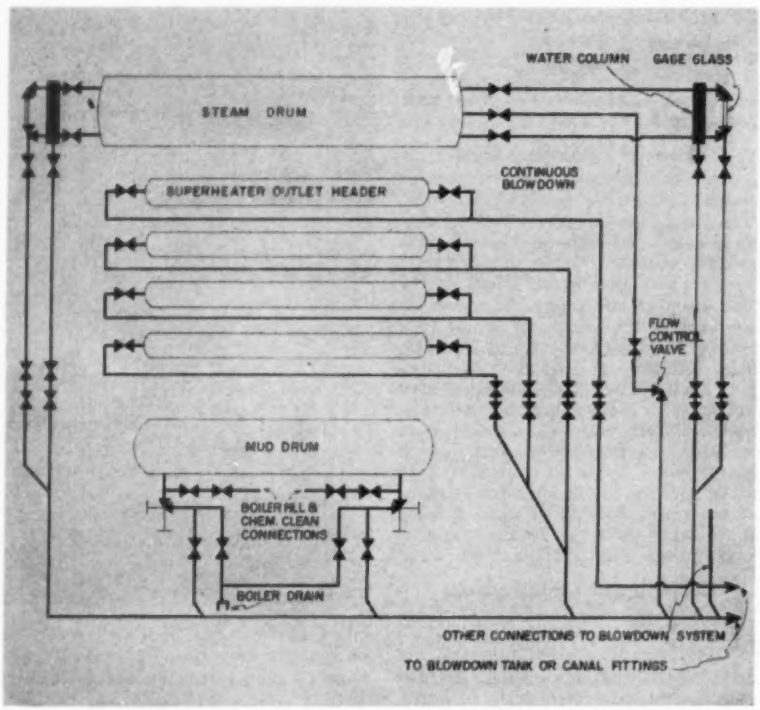



Fig. 1. Diagram showing piping and valves for a typical boiler blowdown system

If an economizer is included in the installation and there is no way to recirculate the water during this period, it may be necessary to feed more water than would normally be required and blow down to maintain proper water level in the boiler to ensure sufficient flow through the economizer. This will avoid steam generation in the economizer and a severe water hammer.

With operating pressures in excess of 400 psi, flat glass water gages are commonly used with mica inserts. To avoid deterioration of the mica, blowdown of these gages, and columns if used with them, is restricted to the minimum required to give the operator a true water level indication. Normally it is unnecessary to blow down with a wide open valve; slowly cracking the drain valve on a high pressure gage will usually suffice. Water columns that have no mica inserts may be blown down without fear of injury.

In addition to the steam supplied to the prime mover (turbine or engine) the boiler must produce enough steam to care for loss through valve packing, glands, loss through steam seals, loss through safety valve blows, supply to process, etc. The steam which passes through the turbine and which is extracted to the various feedwater heaters is eventually transformed to condensate and returned to the boiler by the boiler feed pumps. However, it is necessary to supply make-up water to compensate for the steam lost through glands, etc.

Make-up may be from the softened water system, from a demineralizing system, or from evaporator vapor. In any case, regardless of the purity, chemicals are fed into the feedwater system. For example, sodium hydroxide is fed to insure that the feedwater is alkaline; sodium sulphite is fed to remove the last traces of oxygen following deaeration. Thus the make-up water will contain impurities — either

* Staff Engineer, Burns & Roe, Inc.

those which are naturally present or those which were added to prevent corrosion of the boiler steel.

As steam is generated and collects within the steam drum, the impurities originally present in the make-up are left behind. If no means were provided to eliminate them, eventually these impurities would occupy considerable space and would hamper circulation and heat transfer within the boiler. It is the usual practice to drain off continuously, from about the water level of the boiler, enough water to remove impurities at the same rate at which they enter. The line which leads from about the center of the drum to the blowdown tank is called the continuous blowdown line.

### Superheater Vent

Principal function of the superheater vent is to provide a flow of cooling steam during the periods of boiler start-up. Without such steam flow the superheater tube temperature would approach the furnace temperature (perhaps 2400 F) in the case of a radiant superheater or the flue gas temperature (perhaps 2000 F) in the case of a convection superheater. The boiler manufacturer will calculate the required quantity of steam flow and will provide a valved connection of at least sufficient capacity. However, the boiler operator usually has no direct means of measuring the steam flow and common practice is to open wide the superheater vent valve during starting-up periods. Thus the quantity of steam flow is that which will flow through one or more wide open valves, through a certain selected size of pipe line, and finally into some sort of blowdown receiver.

It should be pointed out that generally the boiler manufacturer will not provide separate vents from the superheater outlet header but will use the drain connections for both drain and vent. They prefer this drain line to be free of any other flow — so it is desirable to run this line as a separate line to the blowdown tank or canal fitting.

### Blow-off Valves

A station which is to run 24 hr a day is called a base-load station. In recent years some utilities have found it necessary to add load for industrial daytime usages, but do not have the need to operate those same units at night — such a plant would be called a peak-load station. This would influence the location of the valves. For example, in a peak-load station with its constant starting and stopping, ready accessibility of valves would be a very important factor.

The prime consideration is to locate valves so that they will be accessible, but at the same time bear in mind that it is desirable to have a closed valve as near as possible to the source of pressure. A valve that may require daily adjustments, such as a continuous blowdown flow control valve, must be installed in a position where it can easily be reached by an operator. Valves should always be located adjacent to platforms — it may be necessary to extend the platform or to pipe up to a platform before selecting the final location.

On drum continuous blowdown, it is preferable to use a flow control type of valve with special disk for close control of flow.

It is preferable to use straightway Y-type of globes in preference to regular globes or gates since the Y-type has less obstacles to cause sediment to pack up or hang up.

It is preferable to double-valve all boiler blow-offs although the Code allows single valve with valve in common blow-off header.

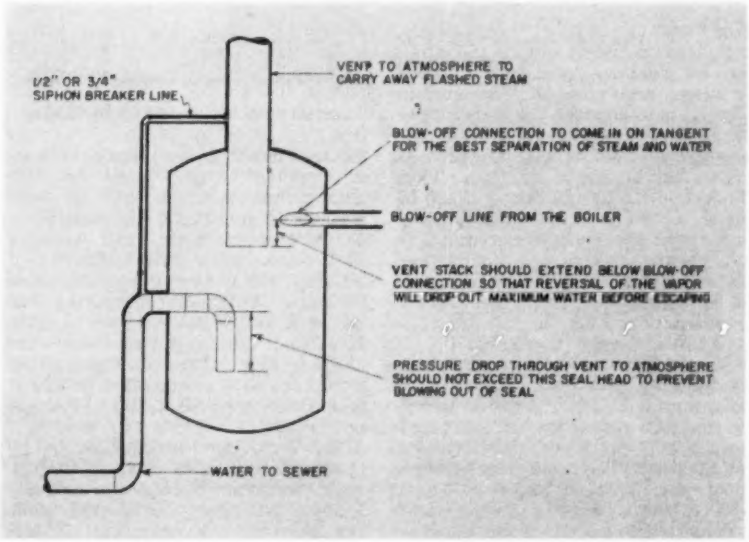

1/2" OR 3/4" SIPHON BREAKER LINE
VENT TO ATMOSPHERE TO CARRY AWAY FLASHED STEAM
BLOW-OFF CONNECTION TO COME IN ON TANGENT FOR THE BEST SEPARATION OF STEAM AND WATER
BLOW-OFF LINE FROM THE BOILER
VENT STACK SHOULD EXTEND BELOW BLOW-OFF CONNECTION SO THAT REVERSAL OF THE VAPOR WILL DROP OUT MAXIMUM WATER BEFORE ESCAPING
PRESSURE DROP THROUGH VENT TO ATMOSPHERE SHOULD NOT EXCEED THIS SEAL HEAD TO PREVENT BLOWING OUT OF SEAL
WATER TO SEWER

Fig. 2. Blowdown tank connections. Text explains simple method for sizing piping

Blowdown tank would be required where a place to dispose blowdown from boiler cannot be found that is acceptable, such as a river or the discharge canal carrying away used condenser discharge water. The object of the blowdown tank is to cool the discharge so it is acceptable for discharge into sewer system. This is done by flashing the blowdown and leaving the dropped out condensate at 212 F for discharge to sewer. Method of sizing the blowdown tank will be given in a separate future article.

Vent on blowdown tank should be carried to some point clear of building to prevent vapor from being pulled into fan suction or fouling coal conveyor system.

It is, of course, less costly not to have the blowdown tank and use sound-muffling canal fittings immersed in the water canal carrying discharged cooling water from condenser. This procedure eliminates both blowdown tank, pit, large vent stack and piping to sewer.

### Sizing Blowdown Piping

There are three items to consider in sizing the blowdown piping: 1. Code requirement as to size and pressure standard; 2. The amount of steam going to blowdown tank from superheater during start-up; and 3. Sizing the piping for flashing.

The Code gives minimum sizes for water column and gage glass, maximum size for drum surface blow-off, and the minimum and maximum for boiler bottom blow-off.

The boiler manufacturer will give the maximum steam load expected through superheater header during start-up.

Sizing the piping for flashing mixtures is a complex problem. However, here are a few guideposts that will aid in approximating the sizing. The key problem to deal with is the erosion of the piping. Since a mixture of steam and water traveling at high velocities through a pipe has erosive action at any change of direction, the piping should be as free from bends and elbows as possible.

To eliminate erosion where these changes in direction of flow must exist, Benjamin and Miller in their article "The Flow of a Flashing Mixture of Water and Steam Through Pipes" [1] have suggested as a criterion a limiting momentum force of 75 lb on a 90 deg elbow $[\sqrt{2}\,(wv+g)]$.

W. F. Allen, Jr. in his paper "How to Size Piping and Valves for Flashing Mixtures" [2] states that in addition to the momentum criterion above, the intensity of force per unit area should be limited to 300 lb per sq ft $[V^2 \div (2vg)]$.

where,

w = Weight flowing, lb per sec
V = Velocity, ft per sec
g = Acceleration due to gravity, 32.2 ft/sec/sec
v = Specific volume, cu ft per lb

The drains or blowdowns from a steam generating unit are of two

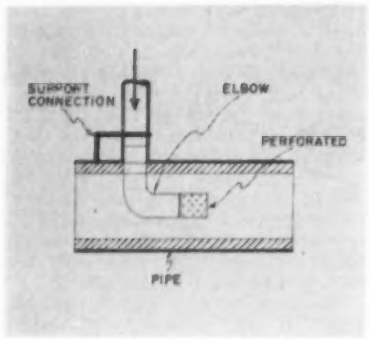



Fig. 3. Typical blowdown canal fitting

types — they either leave the unit in a saturated (or subcooled drains from the economizer) condition or as a superheated vapor from the superheater. In order to calculate the amount of flash, it is necessary to know the condition at the blowdown or drain valve. As the water or steam leaves the unit, there is an immediate reduction in pressure; this reduction in pressure takes place throughout the complete run of piping to the blowdown tank. This final pressure will be that which is maintained in the blowdown tank. The most severe duty occurs when the unit is being started up and the superheater vents are wide open.

### Worked Example

In order to demonstrate the method of approach to this problem, the following data are assumed:

1. It is desired to pass 50,000 lb per hr from the superheater vent.
2. The blowdown tank is to operate under this condition with a pressure 3 psi above atmospheric, or say 18 psia.
3. The steam leaving the superheater is at 1500 psia and 950 F.

It is usual practice to have two superheater vents, one at each end of the superheater outlet header, so that all of the superheater elements will be assured of a steam flow. Thus only 25,000 lb per hr need be passed through each valve.

The capacity of the valve is limited only by its size and initial steam conditions. Directly at the valve, the pressure will be the critical pressure or approximately 55 per cent of the initial pressure in the case of superheated steam. From there to the blowdown tank there will be a gradual drop in pressure caused by friction which increases at a progressively faster rate due to the large increase in specific volume which accompanies reduction in pressure.

Our first step is to estimate the size of valve. We shall use Napier's formula as a first approximation,

$$w = \frac{PA}{70}$$

where

w = weight discharged in lb per sec
p = initial pressure
A = area of orifice in sq in.

Solving for A,

$$A = \frac{70\ w}{P} = 0.324 \text{ sq in.}$$

This would give 0.642 in. dia.

It would thus appear that a $\frac{3}{4}$-in. valve may be satisfactory. However, for structural strength, a boiler vent valve should never be smaller than 1 in. The larger size will also provide a margin for frictional resistance and back-pressure in blowdown line.

Most conservative approach is to assume that the expansion from the superheater occurs at constant enthalpy. This will set the conditions at inlet to blowdown tank.

Let enthalpy of steam at superheater outlet header be $h_1$. The enthalpy of vapor at the reduced pressure condition will be termed $h_{g2}$ and the enthalpy of the liquid, $h_{f2}$. The amount of flash can be calculated by taking a simple energy balance:

$$h_1 = x h_{g2} + (1-x)\, h_{f2}$$

from which $$x = \frac{h_1 - h_{f2}}{h_{g2} - h_{f2}}$$

It may be considered desirable to have a small blow for steam sampling. This might be connected just prior to the sampling cooler to clear the steam line leading to the cooler.

Relief valves on the shell (steam side) and on the head (water side) of a closed heater should be connected to a common line running to boiler blow-off, or to a large stack that will permit flashing so that the steam may separate out and the water be discharged to drain. These valves should be corrected directly to the discharge piping and not through a funnel or drip pan elbow. A test connection with $\frac{1}{2}$ in. globe valve should be taken off near the discharge outlet of the relief valve.

### Code Requirements

Latest requirements of the Boiler and Power Codes should be examined before designing the blowdown system. For example, here are some of the rules governing pipe sizing and pressure standards:

"The water column blow-off pipe shall be at least $\frac{3}{4}$ in. pipe size.

"The minimum size of the steam and water connections shall be 1 in. pipe size and each water glass shall be provided with a valved drain.

"Surface blow-off not over $2\frac{1}{2}$ in.

"Bottom blow-off 1 in. minimum and $2\frac{1}{2}$ in. maximum.

"Blow-off piping shall be designed as for saturated steam in accordance with the following table, but all fittings shall be of steel.

| Boiler Pressure psi gage | Design for Steam psi gage |
|---|---|
| 901 to 1500 | 600 |
| 601 to 900 | 400 |
| 250 to 600 | 250 |
| below 250 | 250* |

"However, boiler blow-off piping that may be subjected to full boiler pressure shall be capable of withstanding full boiler pressure."

[1] The Flow of a Flashing Mixture of Water and Steam Through Pipes, by M. W. Benjamin and J. G. Miller, Trans. ASME, Vol. 64, 1942, pp. 657–669.

[2] How to Size Piping and Valves for Flashing Mixtures, by W. F. Allen, Jr. POWER ENGINEERING, May 1952.

* Except that for boiler pressures in excess of 150 psi steel fittings of ASA 150# standard shall be used.

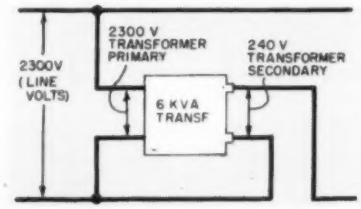
## Standard Transformer as Voltage Regulator

By PAUL C. ZIEMKE

MOST SMALL POWER transformers, with leads brought out of the tank, can be used as regulators to raise or lower line voltage. The normal method is to connect the transformer primary across the line and the secondary in series with the line as shown in the above diagram. Thus the primary voltage rating must be equal to line voltage, and the secondary of the transformer must be able to carry line current. In addition, since the transformer secondary will be at line potential above ground, its insulation must be able to withstand this voltage to ground.

When purchasing a transformer for bucking or boosting service the maximum line current must be known so that the secondary of the transformer can carry it safely without overheating. The following example illustrates this selection.

A 2,400 v line in single phase service with a load of 20 amp requires a 10 per cent voltage boost. 10 per cent of 2,400 is 240, which




Connections for booster-transformer

means that the secondary voltage of the transformer must be 240. The primary, which will be connected across the line, will be 2,400 v; i.e. the transformer will have a 10:1 ratio. With a line current of 20 amp, i.e. a secondary current of 20 amp, the transformer rating will be 20 x 240 = 4.8 kw, say 6 kva. If a 5 per cent boost or buck were needed, then a 20:1 ratio transformer would do, with a secondary of 120 v, and a rating of 20 x 120 = 2.4 kw, or 3 kva.

An important precaution to be observed with this type of improvised regulator is that the primary leads must never be opened while the secondary is energized. If this were done, dangerous voltages could be built up in the primary windings.

# What Ruined the Cooling Unit?

**When refrigerating plant failed to cool rooms, inspection showed badly corroded fans, and highly acid brine. Cause and cure are described, also way ammonia condenser cooling water supply was increased; other changes were made**

**By C. T. BAKER** *

IN AN ABBATOIR, the refrigerating plant comprised four large brine spray units which supplied the necessary cooling effect for the chill and the curing rooms. Each unit contained 840 ft of ¾-in. full weight galvanized flooded ammonia evaporating coils. A 60-gpm, 60-ft head pump, driven by a 2-hp motor, circulated brine from a small mixing tank, attached to the frame of each unit, through several spray nozzles located immediately above the evaporating coils. A 9,000-cfm fan circulated air through the cold brine spray and discharged chilled air to the space to be cooled.

In order to prevent ice formation on the evaporating coils of the units, it was, of course, necessary to maintain the brine at a density that would prevent its freezing.

All units worked perfectly for more than a year. No difficulty was experienced in holding the specified room temperatures during that time. A short time later, however, the engineer was called on the carpet for failing to hold one of the rooms at the proper temperature for chilling the meat. I was asked to investigate the situation and determine the cause of the trouble.

First on the program for inspection were the air circulating fans and the interior of their housing. Three fans were mounted on a common shaft driven by a 3-hp motor through a flexible coupling. These fans were badly damaged and about ready to fall apart. Brine eliminators on the air outlets of the units were almost completely eaten up with rust and some damage to the steel housing was noticed. A check of the brine solution removed from the mixing tank showed a pH of 5.5. The question was: "Why such an acid brine?"

In discussing the situation with the plant engineers, the following facts came to light. The chief engineer, when it became apparent that the salt supply was getting low, notified the manager and asked that an order be placed to replenish it. Several days later, when the supply was finally exhausted, he asked for permission to buy a few bags locally, pending the arrival of the order that allegedly had been placed. This request was refused and the engineer was ordered to obtain the salt immediately required from the hide curing cellar. On several subsequent occasions it became necessary to obtain salt for the air cooling units from the same source.

It should have been evident that salt removed from hide curing cellars is entirely unsuited for making brine which is to be used as a refrigerant. Such salt is highly contaminated, and when dissolved in water, produces a highly acid brine.

The damaged cooling units had to be completely reconditioned, requiring new fans, eliminators and pipe connections between the mixing tanks and the pumps.

When first advised of the damage found, the manager contended that the units were defective and that he would insist upon the manufacturer's making everything good at his own expense. However, upon being apprised of the *cause* of the damage, he quickly dropped the idea of holding the manufacturer responsible.

### Ailing Ice Plant

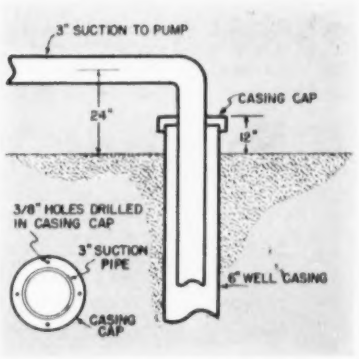
High diesel fuel bills, low plant out-put and the necessity for purchasing ice from a near-by city to make up for the deficit in out-put in August, 1943, introduced some amazing facts during the writers' search for solutions to the plant problems.

The following tabulation of temperatures recorded during the first day of the investigation is revealing:

| | |
|---|---|
| Outdoor temperature | 98 F |
| Water entering double pipe ammonia condensers | 74 F |
| Water leaving condensers | 92 F |
| Temperature difference | 18 F |
| Condensing pressure | 212 psig |
| Suction pressure (Only suction pressure gauge in plant was out of order.) | unknown |
| Water to engine jackets | 74 F |
| Water off engine jackets | 92 F |
| Temperature rise through engine jackets | 18 F |

It was evident that the ammonia condensers were not receiving sufficient water and that the engine jackets were receiving more water than they should if the ultimate in fuel economy was to be obtained.

Plant records, which were anything but complete, supplied very little in the way of equipment history. The only information concerning the pump which supplied water to the condensers and the Diesel engine was that it had been purchased second-hand, and that it was a side suction, top discharge, with a 2½-in. inlet and a 2-in. outlet. The suction pipe between the well and the pump was 3 in. in diameter.




Sketch showing how holes were drilled in cap of pump suction casing so atmospheric pressure could act on well water

The accompanying sketch illustrates how the pump was connected to the well. It is apparent that the pressure of the atmosphere could not act directly on the surface of the water in the well which, naturally, would decrease its capacity. The sketch shows where holes were bored in the casing cap to put the surface of the water in direct communication with the atmosphere. Submergence of the suction pipe below the water level of the well was sufficient to prevent the water from falling below the end of this pipe. After the holes were drilled in the casing cap, the temperature of the water leaving the condensers dropped from 92 F to 80 F and condensing pressure dropped from 212 to 155 psig.

Inlet valves on the water supply to the engine jackets were partially closed to prevent the leaving water temperature from falling below 92 - 95 F. During the following winter, a closed system of engine jacket cooling was installed to permit the run off temperature to be raised to 130 F without danger of scale deposits — a condition that is not possible when raw well water is used direct in the jackets.

Other plant improvements included: installation of a new suction pressure gage; a thermometer on the suction gas inlet and the discharge gas outlet of the compressor; a thermometer on the water inlet and outlet of the double pipe condensers; and a 2-in. diameter liquid header to replace the 1¼-in. size originally installed. The liquid inlet opening in the receiver shell was also increased to 2 in. and a 2-in. line was installed *continued on page 105*

*Consulting Engineer

# Budget Your Water, Save Its Btu

**Surprisingly large portions of your profits can disappear down the drains if you are not doing all you can to prevent leaks, re-use water, extract all possible heat from effluents, and determine your most economical pressure for plant distribution**

Small auxiliary heat exchangers are the most easily justified power plant extra

**By F. X. HALLORAN**

A DECADE AGO, most plant engineers felt that they were conserving water if leaks were held to a minimum and repair crews kept distribution lines and utility tunnels dry enough to work in. Today's plant management, however, requires an efficient and well-maintained distribution system in addition to maximum re-use of water and its heat.

Statistics indicate that basic industrial water usage has increased 40 per cent during the last 10 years. A breakdown of that usage shows the following:

| | |
|---|---|
| Cooling | 53 per cent |
| Process | 31 per cent |
| Boilers | 8 per cent |
| Sanitary | 5 per cent |
| Miscellaneous | 3 per cent |
| Total | 100 per cent |

The largest single application shown is cooling water. This water is not "consumed" in the usual sense of the word, but is pumped and warmed and discharged, normally without being polluted. About 96 per cent of our power is now being generated in steam plants, and in an average steam turbine plant 92 per cent of the total water used is for condenser cooling.

Each plant and manufacturing process has its own individual water requirements, but every installation has demands in common with other plants. Industrial water usage requires careful planning to achieve economy. The main tool for the planning is a complete and continuously maintained plant water balance survey. This water balance should never be regarded as final, but should be continually revised as existing or new processes require increased or decreased water.

When surveying your water setup, make the survey complete. Try for accuracy and remember your future needs. Plan for the future by checking new equipment and maintenance ideas. Don't rely on just one plan, prepare alternates, to provide a choice.

Utilize untreated natural raw water for all possible uses, especially toilets and for raw materials requiring washing to remove foreign matter. It can also be used at those manufacturing stages where chemical residues and unwanted by-products are cleansed from the product. Use raw water around the manufacturing area for washing down floors and especially for irrigation of lawns, shrubbery and flowers.

Often overlooked are the savings from pumping, storage and piping. Oversize piping is a good investment. It provides a plant water expansion backlog and can be adapted in the future without additional distribution costs. Undersized piping means excessive pressure loss, requiring higher system increases and pumping costs.

Keep velocity at 300-600 fpm for general service lines. Water consumption automatically commences as pressure is increased. Greater loss results through leaks and larger waste flow rates through open faucets. Raising pressure from 25 to 45 psi means a 30 per cent greater consumption.

A plant water balance will show consumption during the maximum month to be about 125 per cent of the average month. The maximum week will be 150 per cent of the weekly average. Maximum day will be 175 per cent of the daily average. Maximum hourly flow will be about 150 per cent of that day's average hourly flow.

Rent or buy water meters. They cost little and can produce large savings since the consumption of each unit can be closely checked and watched for abnormal consumption. Checking all departments against the actual water pumped will show some unaccounted for gallonage which can be ascribed to meter errors and possible leaks. Water pressure regulators at strategic spots will further conserve water. And check your pump efficiency. Old pumps are money eaters and often can be improved with new impellers.

Filters are available which even permit the reuse of wash waters. A low-pressure-drop type is preferable. For heavy solids-laden water, a settling basin is used with water being taken from the top through suitable foot screens.

Water heat exchange calculations should be on a Btu basis rather than on temperature alone. Often a higher water temperature can be utilized for the same cooling effect by increasing flow volume, without additional pumping costs.

Rapid efficient cooling requires that the average temperature difference between the water and material to be cooled be kept as great as possible. Low temperature cooling water should initially contact the coolest material being cooled.

Coolers installed in series reduce water demand. Series flow gives lower cooling losses providing greater heat differential, and higher velocity permits greater solids concentration with less capacity loss to solids buildup.

In a turbine cooling system, revamping the different inflow-outflow lines with one single line from the coolest part, the fan bearings, through progressively higher temperature cooling zones, gear reducers, oil coolers, to the hottest turbine bearings, means a 55 per cent reduction in cooling water required.

Thin filmed cooling water is most effective with a greater number of small tubes in an exchanger operating with high velocity flow. Cleanliness naturally affects efficiency, and all

surfaces should be cleaned whenever efficiency drops near 20 per cent.

Inlets and outlets of heat exchangers should be equipped with accurate thermometers. Best practice is to have the cooling water outlet terminate in open funnels which provide a safety check on flow stoppage and also abnormal temperatures. Records of hourly flow and temperature provide a fast check on lowered efficiency.

Small amounts of raw water used on fan bearings, pump bearings, jet condensers on turbine seals and cooling water from air compressors are often overlooked. Vacuum pumps with fresh water seals, water cooled brake drums, all provide water saving sources.

Where elevated water temperatures are a disadvantage, the water can still be used as makeup in cooling towers. Normally, water temperature elevations are minor in other parts of the cooling system and these waters can usually be returned to the main fresh water system.

Leaking faucets and valves are still the biggest water wasters in every installation. The commonplace drop-per-second from a faucet wastes 650 gal annually. Leaky toilet flush valves can cost over 2,700 gal annually. A continuous check on faucet and toilet installations provides a source for saving water in every plant.

Wasted heat in 100 gal of 160 F hot water routed to the sewer is equal to 10 lb of coal or nearly 1 gallon of fuel oil. Waste heat utilized in preheating feedwater gives 1 per cent fuel reduction for each 11 F temperature rise — calculated 0.0909 per degree temperature rise. Thus, feedwater raised from 60 F to 220 F lowers fuel demand 15 per cent.

Incoming 50-F fresh water and 190-F waste water, heat exchange gives a gain of 110 F, as waste goes to sewers at 80 F, and heated water is now 160 F. Additional capacity will naturally bring these temperatures closer, but a differential of 15 to 30 F between waste and incoming fresh water is heat exchange economic equilibrium.

Often overlooked are the many advantages of open type pit heat exchangers. With high solids in hot waste water, a preliminary settling chamber makes it possible to recover this heat where such contamination would clog a shell and tube exchanger. Pit exchangers offer storage capacity so that cool fresh water may be heated anytime as new water demand does not have to coincide with waste flow. As pumps are not required, maintenance is low with pits and tube bundles being easily cleaned with a high pressure water lance.

Shell and tube exchangers have the advantage of being more compact than pit types, easier installed, and are especially suitable when fresh water demand parallels waste flow. For best efficiency, all water flows should closely coincide so heat is always available for incoming fresh water requirements.

It is not necessary to arbitrarily increase heat exchanger sizes selected from manufacturer's capacity tables as published designs are based on extensive field test data. Always select a multi-pass unit within allowable pressure loss limitations. Generally, the greater the number of passes, the more compact and lower priced the unit. Consistent with allowable pressure drop, select the heater with the smaller shell diameter and longer tube length.

Rapid checks when a closed feedwater heater fails to produce usual outlet water temperature should include steam pressure; make sure water has not accumulated in shell; check vents, and if in doubt increase venting. If these items check out satisfactory, the heater has dirty and plugged internal tubes. Tube leakage is easily recognized by excessive water discharged from shell.

Heat exchange selection naturally must be based on an appreciable difference between hot waste water and incoming fresh water — both water movements practically matching each other. Tests should initially be made with a recording thermometer for a true average of hot waste water. Since fresh water temperatures do not vary except with seasonal changes, an ordinary thermometer usually provides enough accuracy.

Heat losses due to internal boiler scale are relatively small, not exceeding 2 per cent. Scale elimination means power savings equalling raising boiler flue gas $CO_2$ about 1.25 per cent. This additional efficiency is easier and more economical to obtain by correct water treatment than by any other available means.

Over a year's time, efficient water treatment will show close to a 4 per cent plant efficiency gain. In addition, clean steam eliminating foreign matter entrained as carry-over, reduces fuel consumption and equipment maintenance costs, and keeps plant safety high.

Moisture in steam means additional trap capacity and trapping points required with a greater tendency for more steam being flashed — often wasted through vents.

Moist steam deposits additional thickness of water films on heating surfaces. These films, together with air, lower heat transfer. Water is 70 times and air 1,460 times *less* effective in conducting heat than is steel.

Water coming out with steam when you test your safety valves shows a priming condition inside the drum. If steam flow fluctuates, keep water level several inches *lower* than normal. Sudden steam demands often tend to pickup water from the surface directly below the steam nozzle.

Before entering an economizer, water should initially pass through a deaerating heater, raising its temperature above 200 F, which will prevent internal corrosion. External corrosion can be avoided by selecting an economizer with heating surface area and rate of heat transfer so that exit gas temperature will not vary below the dew point.

Keep hot water storage steam and return lines as short as possible, mounting the heater as high as practical.

Head will be increased to the receiving tank and traps. Hot water return systems while insuring high temperature water at the faucets always, are wasteful increasing costs 45 per cent due to the large volume of hot water in continuous circulation.

Many plants utilize bare condensate return lines as space heaters during winter months. By insulating and using separate heating systems powered by flash steam during cold periods, savings are possible the year round.

Properly grade and route steam and return lines, bonding joints and insulating every fitting. Keep packing tight around valve stems. Leaks should be stopped whether from a roof, piping or other sources. Water dripping on a boiler will cause damage. Leaky soot blowers externally corrode boiler tubes. Sootblower valves should be kept secure as well as associated piping.

Keep hourly utility consumption records continually checking against design and theoretical requirements. Stagger process steam during daytime hours. A laundry section can easily heat up ironers and presses during off peak hours. Instead of a two-hour warm-up of buildings each morning, extend it to five or possibly six hours.

Industrial uses of water were summarized at the beginning of this article, and study of this tabulation will show a heat reclamation opportunity in nearly six out of every seven gallons of water circulated in industry. This is an opportunity that goes begging for takers most of the time, but it pays off consistently for those few who seriously study heat waste.

Fig. 1. A well-constructed coal pile adjacent to a modern industrial power plant

# Coal Storage for the Industrial Plant

By CHARLES H. MARKS*

**The storage of coal in outdoor piles frequently presents problems of spontaneous combustion and slacking. These conditions can be prevented from arising if correct practice is followed**

ALTHOUGH SMALL and medium-size industrial plants do not usually store large quantities of coal, trouble is sometimes experienced with fires in bunkers and stockpiles (Fig. 2). Suitable mechanical equipment may not normally be available for conforming with the recommended storage methods used by the large utility companies. This article is intended to show how the small and medium-size industrial plant can avoid spontaneous combustion of coal in storage.

### Why Spontaneous Combustion?

Spontaneous combustion of coal can occur only if there is available a sufficient supply of air circulating through the pile to induce combustion. If all air could be excluded from the bulk of coal in a bunker or pile, no heating would take place. As a matter of interest, spontaneous combustion can be completely eliminated if coal is stored under water.

On the other extreme, spontaneous combustion may also be avoided if large volumes of air are allowed to ventilate freely all parts of the stockpile. In this way the cooling effect of the air currents limits the rate of oxidation of the coal mass and thereby prevents spontaneous ignition. Coal above $^3/_4$-in. bottom size may be stored without special storage methods to prevent spontaneous ignition. Indeed, some plants find it advantageous to buy and store double-screened coal. If necessary, this coal is crushed before use.

Most plants, however, buy industrial screenings (nut and slack). The amount of coal stored generally represents from two weeks to two months supply, some of which may be in bunkers or silos, and some in stockpiles out in the open.

Air may enter the stockpile due to wind pressure, through natural ventilation caused by the chimney effect of the pile, bunker, or silo, or because of changes of atmospheric pressures and temperatures.

Rate at which a given coal will absorb oxygen and generate heat depends upon: (1) Size of coal and distribution of sizes; (2) Condition of ventilation throughout the storage pile; (3) Temperature; (4) Moisture.

### How Coal Segregates

When coal containing a range of sizes is spilled on a conical pile, segregation takes place in the manner shown in Fig. 3. Large pieces accumulate in the outside layer, and

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Fig. 2. Coal pile fires like this are costly and unnecessary. If properly layered and compacted, even the lowest rank coals can be stored with complete safety

there is a decrease in size towards the center. Due to the higher resistance of the packed fine coal to air flow, the rate of ventilation decreases towards the center; but, at the same time, the exposed surface of coal particles increases due to the increased fineness. At some place inside the coal pile, conditions of oxygen supply and exposed surface reach an optimum which favors a maximum rate of oxygen absorption.

Chemical reactions double for each 15 F temperature rise, but there is also increased heat loss due to the increased rate of ventilation caused by the temperature difference inside the pile and out. The balance of heat released as against heat lost will determine the subsequent heating of the coal pile.

### Importance of Moisture

Presence of moisture, both surface and inherent, has an important bearing on spontaneous combustion: Surface moisture may react with pyrites present in the ash; in this process, iron sulphate and sulphuric acid are formed, accompanied by evolution of heat. Inherent moisture escaping due to heating in the summer produces fissures in the coal particles. High moisture coals, such as lignite, subbituminous, and some bituminous C coals break up noticeably during prolonged storage. This process is called slacking or weathering, and its net effect is to increase the coal fines and therefore the exposed coal surface. Rain or water running into a stockpile may cause segregation. Fines may be washed down and compacted at the bottom of the pile leaving larger areas open for an increased supply of oxygen.

Relative importance of these factors to the possibility of spontaneous combustion depends on the type of coal stored. Generally speaking, the reactivity of a coal (that is, its readiness to combine with oxygen) increases with decreasing rank. This means that as we pass from anthracite through bituminous coals to lignites, the coals tend to combine more easily with oxygen.

Combined effect of the higher reactivity of lower-rank coals and their higher moisture content increases their tendency to unite with oxygen. It may be concluded that the risk of spontaneous combustion is higher with low-rank coals than high-rank coals. More care will therefore be required when storing low-rank coals if spontaneous combustion is to be prevented.

Contrary to widespread belief, the loss in heating value of bituminous coals due to storage is small. Studies by the U. S. Bureau of Mines have shown that the loss in heating value of eastern bituminous coals is usually less than 2 per cent after a number of years' storage. Low-rank coals may lose something like 5 per cent of their heating value in three years.

With some of the lower-rank coals

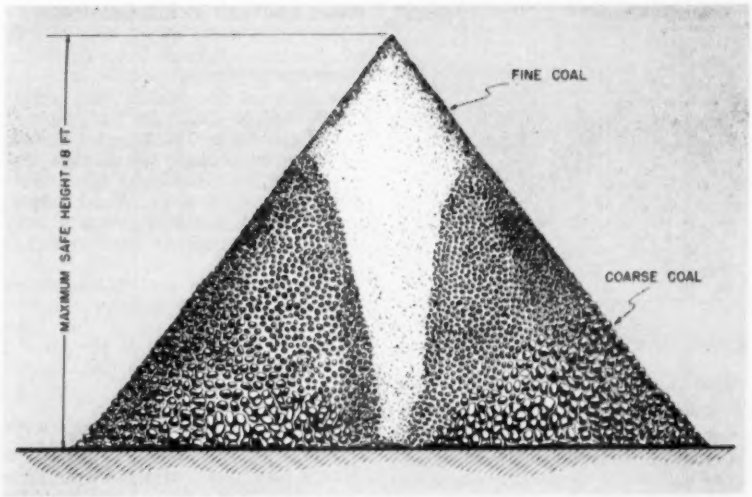



Fig. 3. This is the typical segregation pattern of lumps and fines in a conical coal pile formed by dumping. If height is more than 8 ft, fire can be expected

Fig. 4. The drag scraper (arrow) is useful in building large piles by layering

Fig. 5. Bulldozers and carry-alls are popular for pile building by compaction

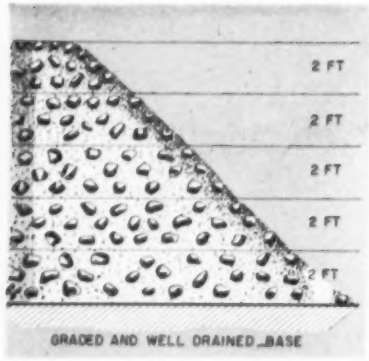



Fig. 6. Correct method of stockpiling coal; lumps and fines well intermixed

the loss of heating value may appear to be higher due to the degradation in size occurring during storage.

The average small and medium-sized industrial plant does not have available special equipment to stockpile large quantities of coal over long periods of time. By the observation of a few principles, the risk of fires in stockpiled coal is considerably minimized with most coals found and used in the United States. The safest method of storing coal for the average plant is the use of enclosed concrete bins or silos. The bins are roofed and the movement of air is restricted so that the danger from spontaneous combustion is at a minimum. Where coal has to be stored out in the open the following precautions should be taken:

1. *Coal size:* Coarse run-of-mine coal is the most difficult size to store because segregation is almost impossible to avoid without special equipment.

Clean double-screened coal may be stored satisfactorily if care is taken to avoid undue degradation and production of fines.

Nut and slack coal must be well mixed and laid down in such a way that segregation is kept to a minimum.

2. *Size of coal pile:* Conical coal piles should be kept to a maximum height of eight feet. The piles should be arranged in such a way that they overlap.

3. *Unloading of coal:* Coal should be unloaded with a minimum drop. The discharge end of a belt conveyor should be lowered to the top of the pile before unloading.

4. *Temperature:* As the rate of oxidation increases rapidly with temperature, any outside source of heat must be avoided. Do not store coal near steam pipes, smoke stacks, hot water tanks, hot drainage or condensate pipes, furnace walls, or the like.

At least one coal producer warns against stockpiling coal in extremely hot weather.

5. *Drainage:* A factor frequently neglected is the drainage of the storage site. Surface moisture in the green coal and additional moisture due to rain must be allowed to run off. Surface drainage from adjoining property must not come into the storage area nor should roof drains be allowed to empty on the pile.

6. *Other factors:* Before storing coal in the open, prepare the storage area by thoroughly cleaning it and removing all foreign matter. Wood, paper, and other inflammable material may promote spontaneous combustion in the pile.

Piling new coal next to coal which has been in storage for some time is not recommended as it has been known to cause a fire at the area of contact. Store such coal in separate piles.

## Storing With Special Equipment

Some of the smaller industrial plants and most of the larger ones have special equipment available for storing coal. Drag scrapers (Fig. 4), bulldozers, and tractors (Fig. 5) may be used for such operation. These machines are used to lay down the coal evenly in layers of one to two ft and compact each layer before proceeding to the next one (Fig. 6). In this manner piles may be built up to a height of 20 to 30 ft or more and large quantities of coal may be stored on a given area. Success or failure of the multiple-layer method is largely dependent upon careful control for avoidance of segregation.

Sides of the completed storage pile should be graded to provide for drainage. As added insurance for long periods of storage, a 12-in. layer of fine coal should be applied on the whole pile. The use of hot asphalt or similar products has also been suggested but in the case of highly reactive coal this method cannot be recommended.

## Storage of Low-Rank Coal

A very interesting report was recently published by the U. S. Bureau of Mines entitled Storage of Low-Rank Coal (see References). This report describes experiences and detailed investigations into the storage of lignites and subbituminous coals, all of which are highly reactive. The experience gained should be of some value in the storage of higher-rank coals because the techniques found successful for the storage of low-rank coals would be even safer for less reactive coals.

Figure 7 is a summary of observations taken on a 5000-ton stockpile of "subbituminous A" slack coal. The pile was built up correctly by increment layers of 6 in. after compaction to a height of 9½ ft. Packed densities were calculated at between 50.4 to 63.2 lb per cu ft. The side slopes of the pile were kept to 14 deg or less to prevent segregation and to facilitate compaction. The surface of the finished pile was smoothed to minimize differential pressures owing to wind. No additional capping of any kind was used.

Chart shows $CO_2$ percentage and temperature of the pile at a depth of three ft from the top. It is seen that a maximum temperature was reached in about 180 days after completion of storage. At that time the gas composition inside the pile consisted of 10.5 per cent $CO_2$ and less than 1 per cent $O_2$. After this point the temperature began to fall off although the oxygen content increased slightly. Temperature of the coal followed the average ambient air temperature very closely, but was about 25 F higher at the peak. Report says that a year later similar temperature and gas analysis surveys were made which showed that the pile conditions "paralleled those observed" previously. As of March, 1953, this experimental pile had been "in place for approximately five years, and at no time has there been any indication of abnormal heating."

## Coal in Bunkers and Silos

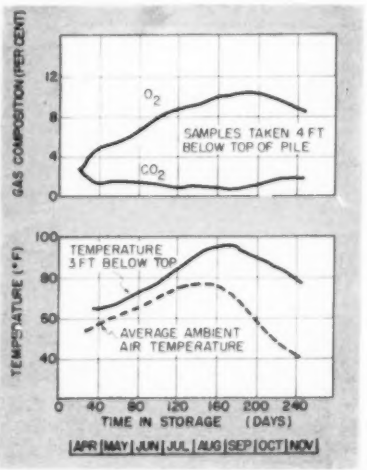
Spontaneous combustion may also occur in bunkers and silos with some bituminous coals. Air enters the coal through leakages around gates and valves and when coal is withdrawn. Segregation often occurs, and at some place in the stored coal, surface area of fines and rate of ventilation may be such that continued oxidation will lead to rapid heating.

Fires in bunkers may also start in coal which is hanging up or remaining in dead storage, such as in the adjacent areas around the outlet. The risk of such fires may be reduced by making sure that all parts of the silo or bunker are regularly replenished with fresh coal. The study of bunker design is therefore not only a question of efficient coal handling but of eliminating the risk of spontaneous combustion.

Attention should be paid to the following items:

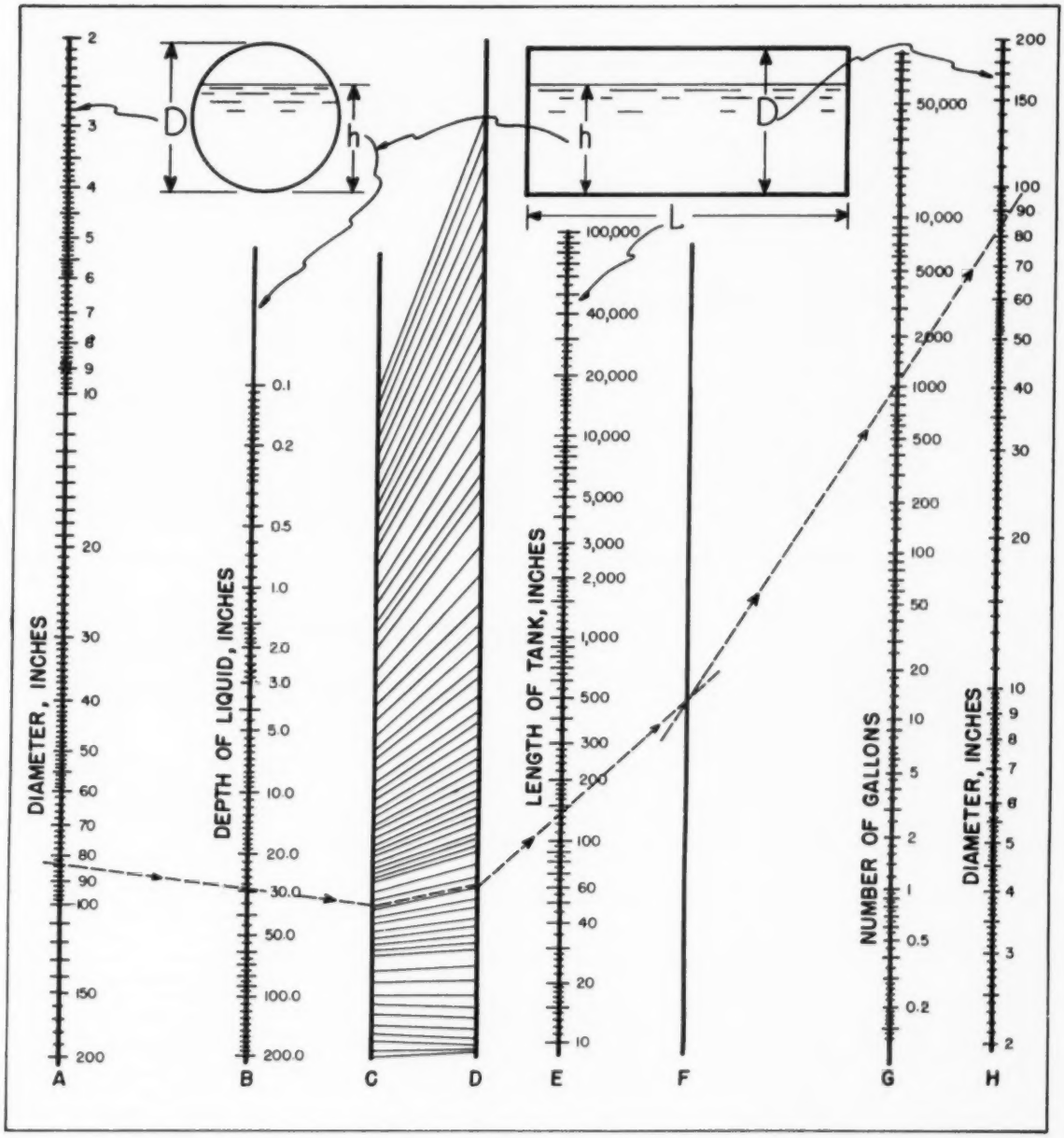
1. Make sure that bunkers are emptied completely every one to six months.

*continued on page 109*




*Data from U. S. Bureau of Mines*

Fig. 7. Temperature and gas analysis of subbituminous slack coal in pile




# Chart Figures Horizontal Tank Capacities

TO FIGURE the number of gallons of a liquid in any horizontal tank without the use of tables, formulas, figures or computations . . . simply start at the left of the chart, and zigzag a ruler or thread across the chart three times as demonstrated by the dotted lines, and the number of gallons is readily found in column G.

For example, how many gallons in a tank 84 in. in diameter, the depth of liquid being 30 in., and the length of the tank 142 in.? Run a straight line through the 84, column A, and the 30 in column B and find the intersection with column C. By means of the eye follow the radiating "guide lines" to column D, find a second point of intersection. From this latter run through the 142, column E, and locate the point of intersection in column F. Then from this point run over to the 84, column H, and the intersection in column G will be found to be close to 1,050 gallons, which is the answer.

This chart takes care of any depth of liquid from 1/10 in. to full capacity of the tank. The small sketches show the diameter of the tank "D", depth of liquid "h" and length of tank "L" with wavy arrows leading from them to the proper columns.

Inversely, the chart may be used to determine the length of tank necessary to hold a given number of gallons where the diameter of tank and depth of liquid are known.

This chart is printed through the courtesy of the Armstrong Machine Works. Copies on stiff paper are available and will be sent upon request to the Editor. Be sure to give your title and company.

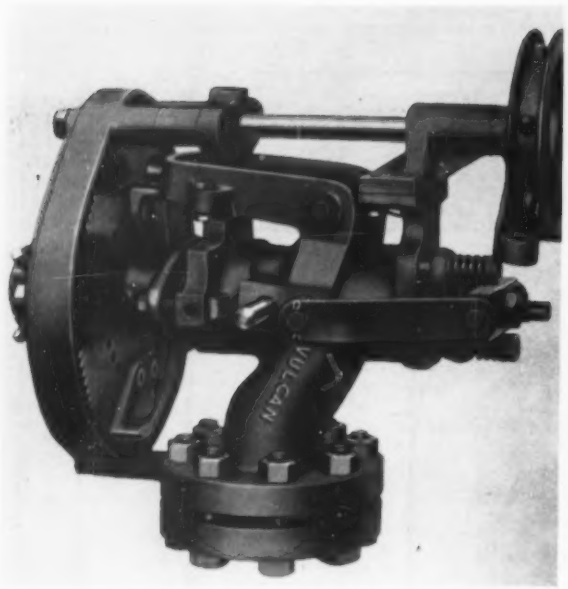



Fig. 1. Manually-operated blowers serve small boilers well

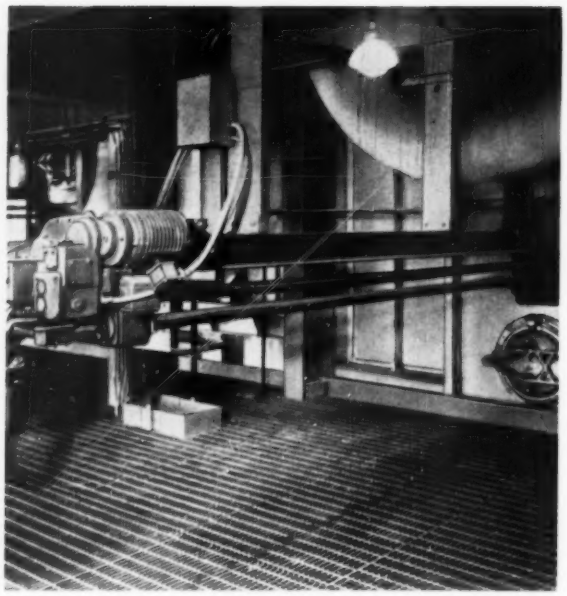


Fig. 2. Semi-automatic electrically-driven blower station

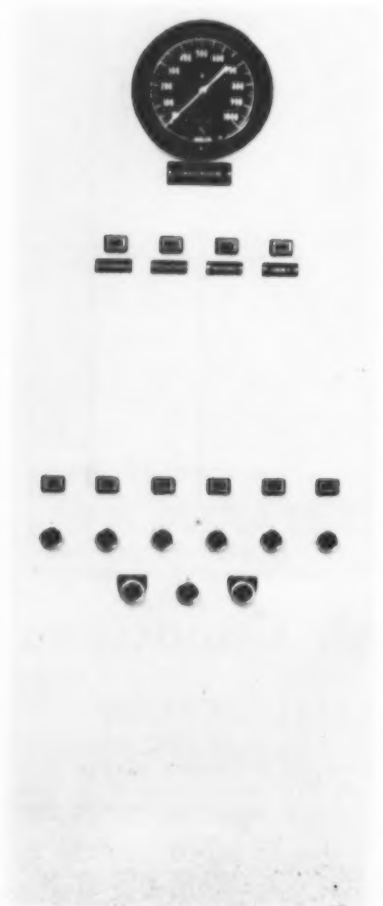


Fig. 3. Automatic blower central control station which has separate push button control of each of its soot blowers

# Automatic-Sequential Boiler Cleaning

**Varying degrees of automation of the old job of "soot blowing" are justified on the basis of variables in boiler design and operating procedures. This article discusses the reasons why one well-engineered system is not equally applicable to all boiler installations**

**By S. F. WALLEZE** *

AUTOMATIC-SEQUENTIAL boiler cleaning systems are exactly what their name implies. They automatically start each blower at the proper time so that all operate in the desired sequence. A true automatic-sequential system, properly engineered, controls itself to indicate and compensate for boiler conditions, brings to a central panel a complete picture of blower operation, and indicates any malfunction.

"Automatic-sequential" has sometimes been used to describe systems that should legitimately be classed either as "automatic" or as "sequential," but not both. To differentiate between these classifications, a brief description of five available boiler cleaning systems is as follows:

(1) Manually operated (see Fig. 1): Chain or crank-operated rotary or gun-type short retractable blowers.

(2) Semi-automatic (see Fig. 2): Powered blowers (air or electrically-driven) with *local* control station.

(3) Automatic (see Fig. 3): Powered blowers with central control panel having a push button for each blower.

(4) Sequential (see sketch in Fig. 4): Powered blowers with a *single* push button for *all* blowers. Blowers start each other by interconnected control system.

(5) Automatic-sequential (see Fig. 5): Powered blowers with central control panel having individual manual push button as well as fully-automatic control for *each* blower.

(6) Automatic-sequential (see Fig. 6): Panel may contain control interlocks with visual and/or audible signals for blower operation.

All of these systems have one thing in common; each is custom-engineered to the boiler which it will serve.

Since the important contributions of an automatic-sequential system include reduction of manpower requirements and most effective cleaning, the system must also be engineered for the specific *plant*. The final design should take into account many factors (enumerated later), including the available manpower at the plant.

To better evaluate the contributions of an automatic-sequential system, a study must be made of the relative advantages of the other systems available. For example, while a

* Copes-Vulcan Division, Continental Foundry and Machine Co.

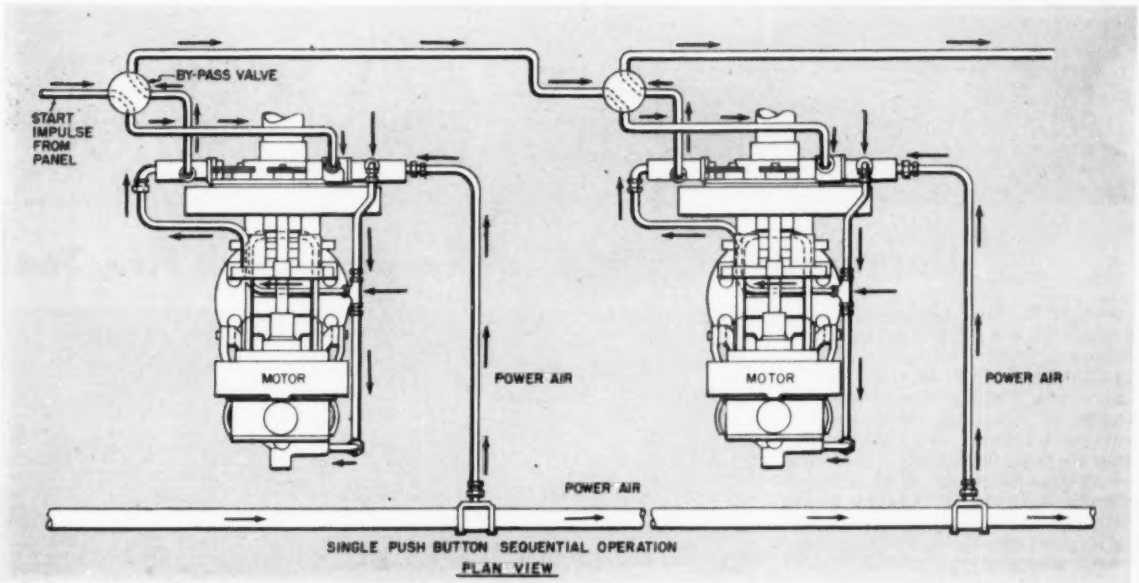



Fig. 4. Interconnected sequential blowers are actuated by one push button, after which each operates in the proper sequence

manually operated system can be purchased with the lowest initial capital investment, the "savings" may soon be sacrificed in the labor cost required to operate it, and by excessive consumption of blowing medium. This, of course, varies directly with the size of the boiler. Therefore, the larger the boiler, the greater the justification for automatic-sequential cleaning.

Even if manually operated soot blowers were converted to power operated units, as with semi-automatic or automatic systems, it would still be necessary for the operator to start the units and stand by while they operated. While automatic or semi-automatic systems save blowing medium, the man-hour requirements are not appreciably reduced. The advantages of these systems, therefore, are limited to decreasing physical effort and conserving blowing medium. Such systems are desirable for relatively small boiler plants. Since no man-hours are saved, the added investment for powered blowers is hard to justify for large central station boilers unless they also have automatic-sequential control.

Single push button sequential systems (Fig. 4) are desirable in small boiler plants and for marine installations, especially when used with intermittent air blowing systems. They are not as desirable on boilers requiring more than a dozen blowers. There is no flexibility of control over blowing sequence. Blowers in dirty sections of the boiler cannot be reblown without repeating the entire cycle. By-pass valves can isolate a blower from the system, but on large boilers this becomes a cumbersome process. Advantages of the single push button sequential system are, therefore, limited to small installations.

Many operators with incomplete automatic-sequential systems in their plant prefer to have a man follow the blowers to assure that they operate, or to detect and correct malfunctions. Such sequential operating procedure is hard to justify from the investment and cost aspect. The reason is simple; the additional cost contributes nothing to the saving of manpower or to efficient operation.

To select a proper boiler cleaning system for a plant, an analysis of all factors must be made. Some of these are:

(1) Geographic location of plant.
(2) Indoor or outdoor construction.
(3) Size and design of boiler.
(4) Fuel burned and firing method.
(5) Types of cleaning equipment required.
(6) Blowing medium — air or steam, or combinations thereof.
(7) Power medium — air or electric.
(8) Amount and caliber of manpower available.

If the analysis indicates an automatic-sequential system is desirable, the following should be considered in the final evaluation.

(1) Relative importance to the specific boiler plant.
(2) Contribution to efficient operation by:

A. Properly cleaning heat transfer surfaces *continued on page 110*

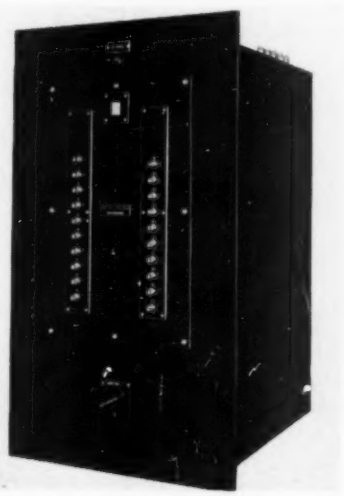


Fig. 5. Automatic-sequential system can operate blowers out of turn, but does not indicate or correct malfunctions

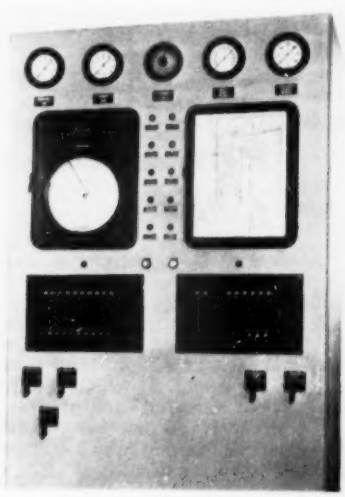


Fig. 6. Complete automatic-sequential systems anticipate, annunciate and correct malfunctions during blowing cycle

# PRACTICAL ENGINEER and ELECTRICIAN SECTION

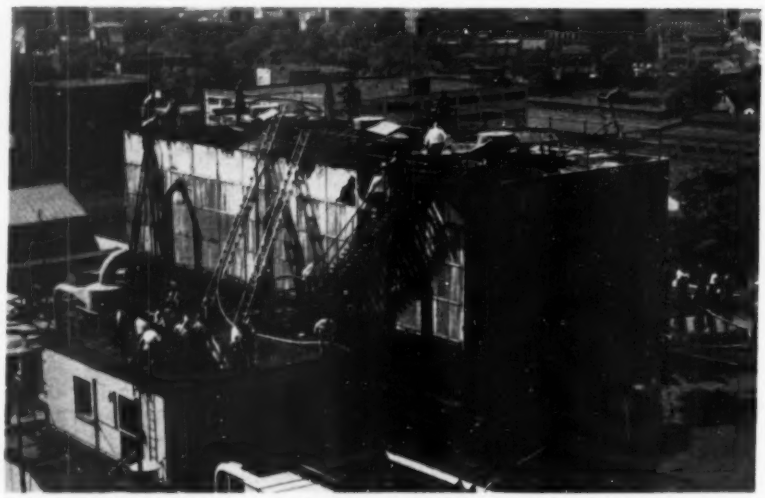
## Unprotected Cooling Towers Can Catch Fire, Too

ONE OF the last things you expect to catch fire is a water cooling tower, which has water continually cascading through it. Yet, as this illustration shows, cooling towers are destroyed by fire, and there are two very good reasons why fire precautions are more important for cooling towers than for many other pieces of equipment. In the first place they are costly to construct and usually essential to plant operation, and they may present a serious exposure fire hazard to important nearby buildings.

The cooling tower fire illustrated in the photograph started when a coupling broke on a fan in a housing on the roof of an induced draft tower. Eventually, friction caused hot metal to drop onto the wooden slatting below, causing a fire that did considerable damage and, what is more important, put the tower out of service for eight weeks.

There are three types of cooling towers. The induced draft type, roofed over and having fans at the roof; the forced draft type with no roof and with fans at the bottom; and the natural draft type.

Induced draft types are most prone to fires. The wooden roof can catch sparks from incinerators, yard fires, and other sources. The fan motors and wiring at the roof present a hazard, and there is a space of about 3 ft below the roof and above the water outlets that contains framing not wet down by the cooling water. This part of the tower should be protected by automatic sprinklers.



Broken coupling in roof-mounted fan dropped molten metal through wooden frame of this induced-draft type tower, causing a fire in dry area (top of the structure)

One type of cooling tower is constructed of galvanized metal and is entirely fire proof.

Any wooden cooling tower should be located at least 40 ft from incinerators, process stacks or other ignition sources. Those which must be closer should either be the non-combustible type or, if this is impossible, the wooden interior should be enclosed by a galvanized metal shell.

Maintenance men should inspect induced and forced draft towers during each shift, checking for excessive heat, noise, or vibration, and semi-annually an inspection should be made by a trained mechanic. This should include a careful examination of the fan equipment and sprinklers.

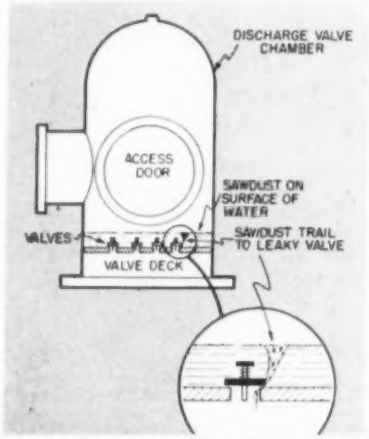
Hydrants with fully-equipped hose houses should be available within 200 ft of combustible towers.

## Spotting Leaky Duplex Pump Valves

By ALBERT H. MOULTON

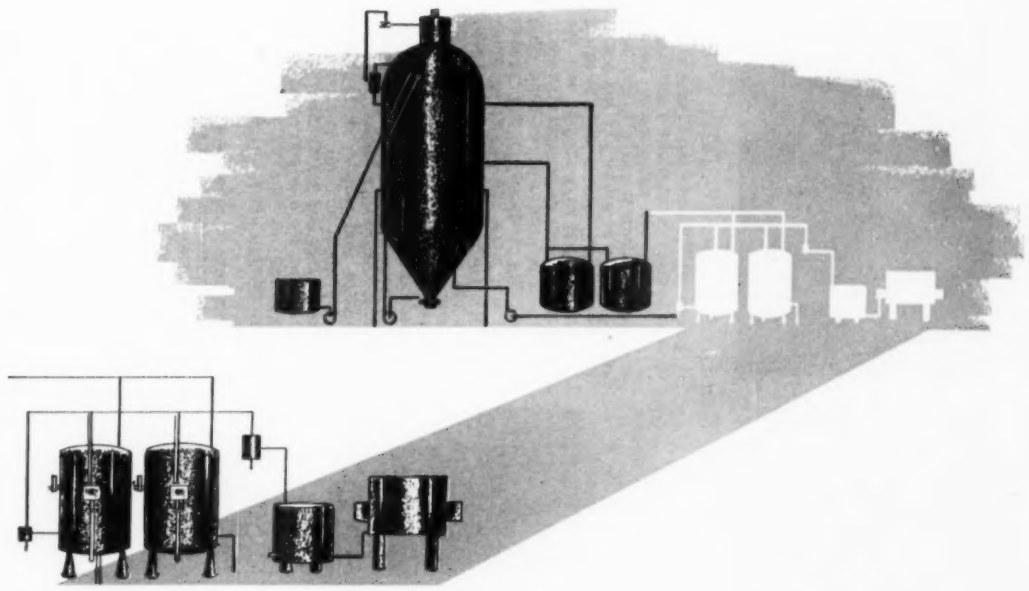
DESPITE trash racks and screens, the valves in a 5,000,000-gpd duplex pump serving a steel mill required much attention. Fine trash and grit passing through the usual protection would lodge under the valves and cause leakage. This pump had four single-ac ing plungers, which meant four valve chambers. Each of these had a deck of 60 suction valves and a deck of 60 discharge valves, for a total of 480 valves in all.

Overhauling that many valves was a big job, especially since only one man could work in the valve chamber at a time; also, each valve had to be lifted and examined minutely to determine which were the leaky ones. A routine was established for inspecting the valves on one side every other Sunday, since this was the only time the pump could be shut down. This made a good day's work for two mechanics every Sunday until someone had the following ideas:




Discharge valve chamber showing trails left by sawdust to leaking valve ports

By flooding the valve decks with water, a check could be run on the severity of leakage by the time it took the water to drain off. This helped, but it was not until someone else suggested putting finely pulverized sawdust on the surface of the water that much time was saved. When sawdust was floated on the surface, leaks were promptly located by the trail of sawdust leading directly to them. This meant that only the leaky valves had to be dealt with and the rest were untouched.



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# Vise Advice

By JOHN J. O'BRIEN

BENCH VISES are so commonplace that recommendations for their improvement are usually considered superficial. While this is partly true, it is also true that any improvements in vises are passed along to jobs which really are significant. The following ideas should be examined with this in mind.

Plates and discs are difficult to hold in an ordinary vise, for example, and this fact led to the plate vise shown in Fig. 1. It consists of two angle irons, two brace screws for the inside legs, and three (or four) steel pins to grip flat pieces edgewise. The piece is also supported from below by the shoulder.

Jaw pads to prevent marring work in a vise are shown in Figures 2 and 3. In Fig. 2, a rectangular hole is cut from a piece of soft material so that it fits snugly over the ram when it is flexed. This prevents its falling out when the vise is opened. The soft clamps in Fig. 3 are cut from thick-walled rubber hose.

An adjustable stop has been fitted to the vise in Fig. 4 to facilitate cutting pieces of equal length. The washer next to the vise jaw serves as a guide for the saw, but will not damage its teeth as would the hardened vise jaw.

Figures 5 and 6 show a handy tray to catch small pieces as they are cut off.

Fig. 2. Leather, cardboard, packing or any of the softer metals can be made into a soft-jaw pad that won't fall out when the vise jaws are opened

Fig. 3. This rubber hose soft-jaw is handy for gripping highly polished or very soft surfaces. Do not let metal particles stay in rubber faces

Fig. 1. Plate-vise jaws are removable. Holding pins are driven in best holes for good grip, vise tightened, brace screws extended to hit other leg

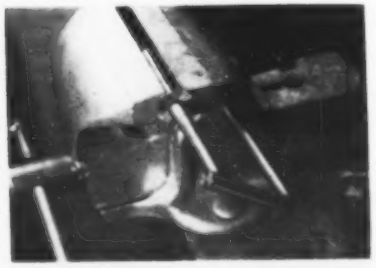


Fig. 4. Pieces of exactly same length can be cut from rod or tube stock with one setting of this stop. Drill for stop, drill and tap for setscrew



fold along this line — outside edges toward you

Fig. 5. Catch pans such as these are handy for one-armed mechanics who do not like to look under the bench for small pieces dropping to floor

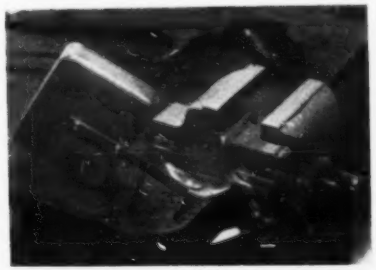
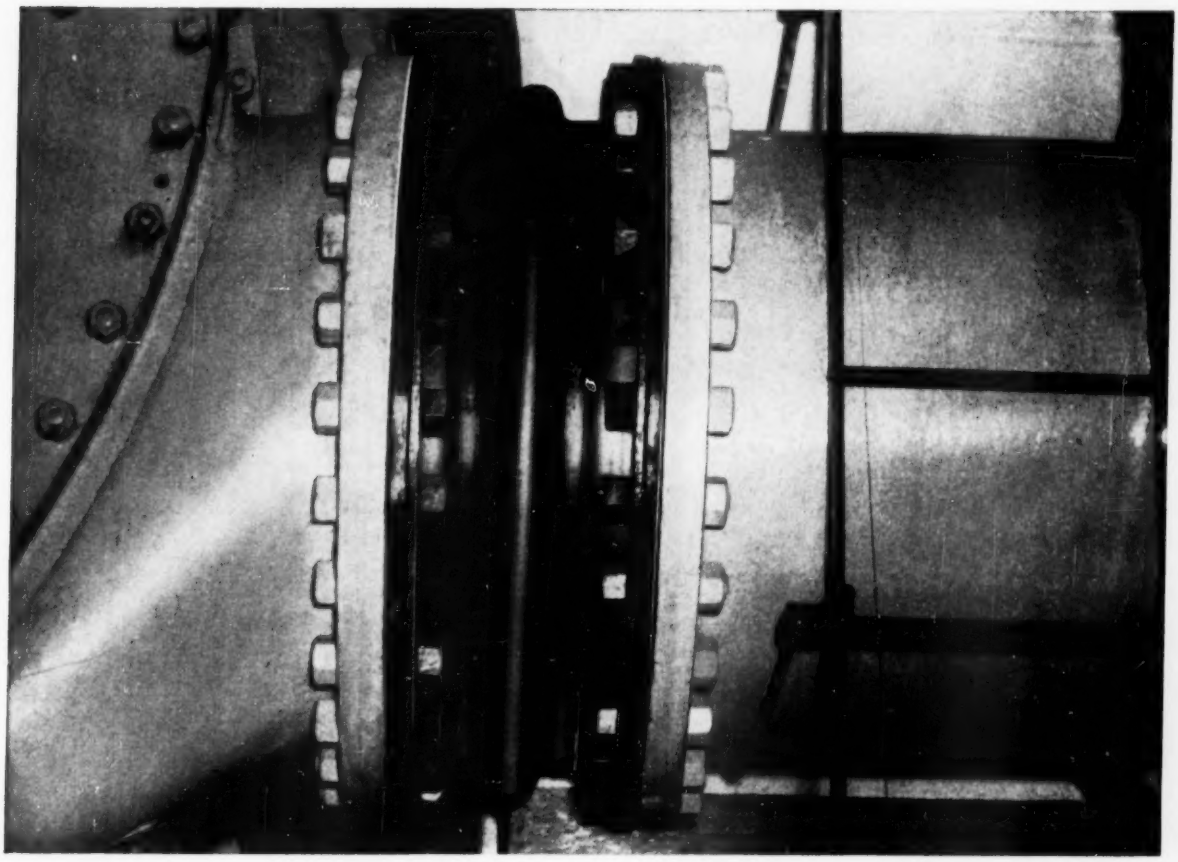


Fig. 6. If you really want one, fix it up with a ram clamp. This keeps the catch pan in position when the vise is loosened and work is extended

## Thread Seizing Stopped by Liberal Dose of Milk of Magnesia

Furnace nuts and bolts are kept turnable at G.E.'s Thomson lab by coating the threads with the old home remedy, milk of magnesia. Brushed on the threads, it has kept them from seizing at furnace temperatures high enough to melt a brass doorknob

# 28 years old... but there's a lot of life in the old joint!



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# Vertical Slides Increase LATHE VERSATILITY

By F. E. RILEY

VERTICAL slides are available from the range of accessories offered by some lathe manufacturers and are particularly useful in maintenance shops which may be short of equipment. By fitting a plain or universal vertical slide to the lathe cross slide it is possible to carry out a wide range of milling and drilling operations.

The vertical slide is primarily a T-slotted table for holding work which may be traversed vertically or horizontally in relation to cutting tools held in the lathe headstock chuck. A typical universal slide as fitted to a small engine lathe is illustrated in Fig. 1. The slide shown is called universal because the T-slotted table may be swivelled about a horizontal and a vertical axis and can be locked in any desired angular position. Angular settings are obtained by calibrations in degrees which are engraved on the castings forming the body of the slide.

With the universal slide it is possible to obtain the two positions of the plain vertical slide, together with any intermediate positions and these can be set to a fair standard of accuracy by means of the protractor scales provided. If used properly, the vertical slide can perform a variety of machining operations to a fairly high standard of accuracy. For example, the duties of a jig boring machine can be simulated by using the vertical slide, whether plain or universal. The work can be mounted on the T-slotted surface so as to face the lathe headstock chuck and any drill or milling cutter gripped therein. By using the cross-slide micrometer dial, together with the micrometer adjustment of the vertical slide, holes may be positioned accurately over the surface of a piece of work by moving the work with the slides.

It is normally assumed that work pieces will be secured to the face of the vertical slide by means of T-bolts engaging with the T-slots and the usual clamp plates and packings. It is a much more convenient arrangement if a sturdy machine vise is bolted to the T-slotted plate, for holding the work. Such a vise is shown in place on the work table of the slide in Fig. 2.

The work support offered by the universal slide cannot be expected to equal that of a proper milling machine, but the example shown in Fig. 2 does indicate that serious milling operations can be undertaken. The success of milling operations, particularly the rate of stock removal and freedom from vibration, is largely dependent upon the sharpness and free-cutting action of the milling cutters used. In the Fig. 2 example, a four-flute spiral and milling cutter is mounted with its shank gripped in the self-centering headstock chuck.

Keyways are cut by bringing the work into contact with the end of the revolving cutter with the longitudinal saddle feed. The work is traversed past the cutter by means of the lathe cross slide. Gripping the work in the vise is a simple operation and centering of the round bar for keyway cutting is achieved by adjusting the vertical position of the work table.

Centering of cylindrical work pieces with the lathe axis is accomplished in the manner illustrated in Fig. 4. A small and sensitive dial indicator is mounted on the lathe chuck. The feeler of the indicator makes contact with the upper surface of the round work and is then turned through a half-circle by revolving the chuck by hand so that the indicator reading can be checked with the feeler making contact with the under-side of the bar. Incidentally, to read the dial when it is facing downward, a small mirror laid on the lathe bed will show the position of the pointer, without the lathe operator having to crane his neck into awkward positions. The vertical slide is adjusted by means of the screw and micrometer dial until the indicator reading is the same with the feeler in contact with the top or bottom of the bar.

The same method of centering a round bar with the lathe spindle axis can be used for cross-drilling shafts. In this case, a suitable twist drill would be substituted for the milling cutter shown in Fig. 2.

In Fig. 4 the method of mounting the dial indicator is of interest; the shank of the indicator fits into a hole drilled axially up a short piece of aluminum rod and is locked in place by a radially-placed set screw. At the other end of the aluminum holder is a powerful circular permanent magnet. These magnets have a small hole drilled through the bridge between the pole pieces and into this can fit the threaded end of the aluminum holder, where it is secured by means of a nut. The magnetic holder allows the dial

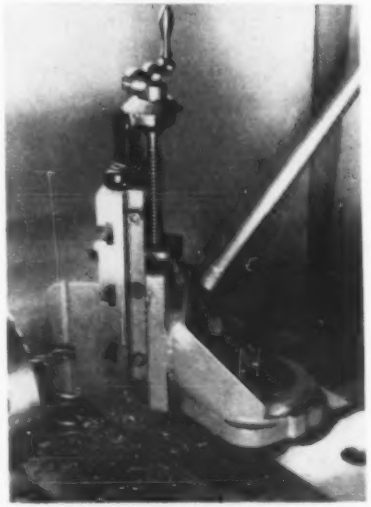

Fig. 1. Lathe with universal slide used as milling machine. Here, V-groove is cut in vise jaw

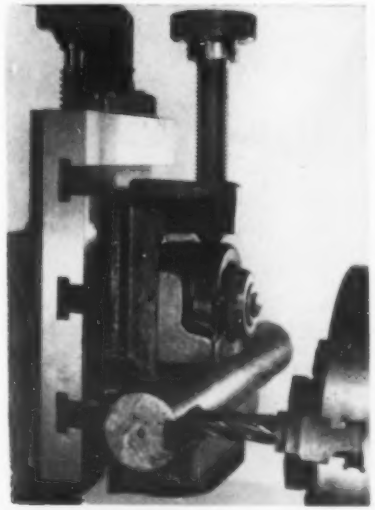

Fig. 2. This blind-end keyway is milled in three passes. Vise replaces the typical T-bolt clamps

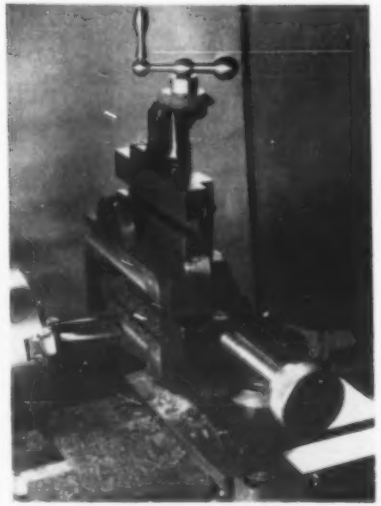

Fig. 3. Awkward pieces are held stationary and tool mounted in chuck for flat surface milling

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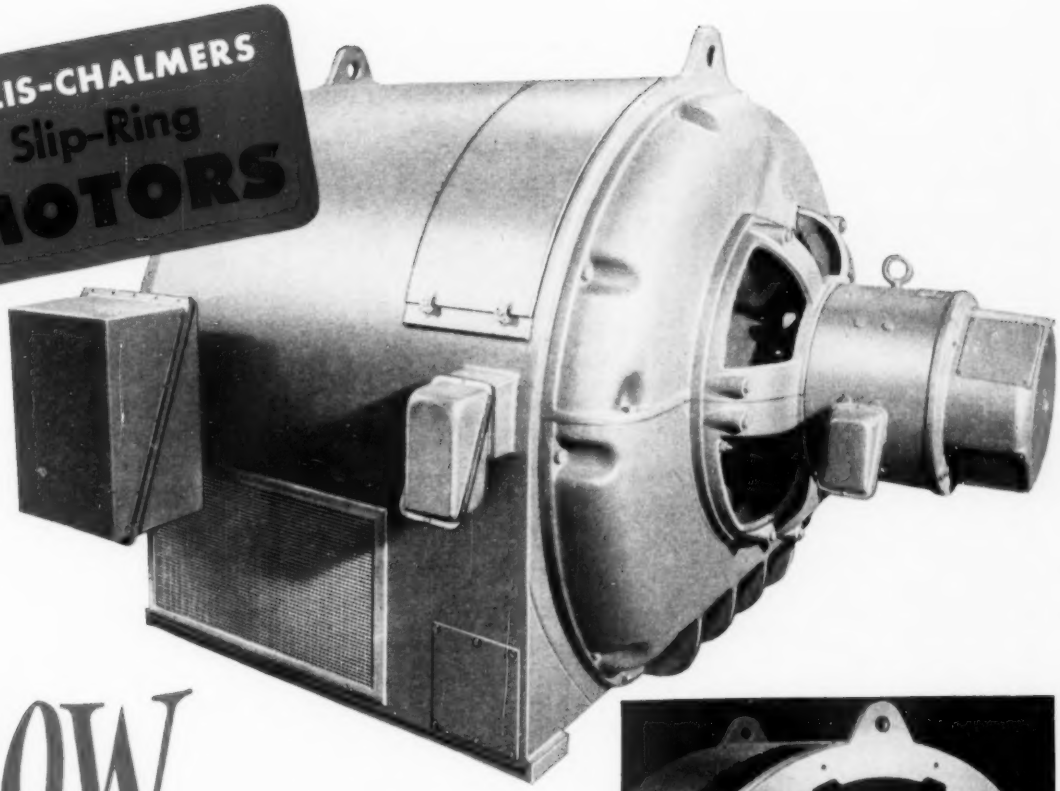

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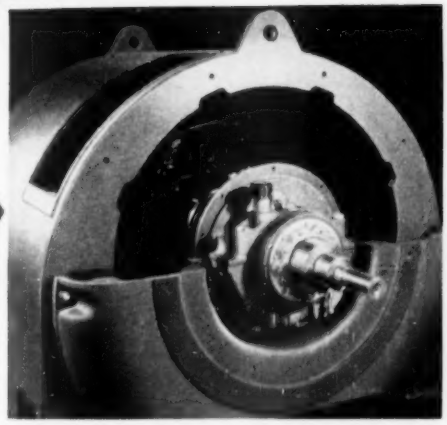

* New Allis-Chalmers slip-ring motor with inspection cover and upper half of end shield removed. Note accessibility of brushes, protection of bearing.

ALLIS-CHALMERS LARGE SIZE SYNCHRONOUS AND WOUND-ROTOR MOTORS have been completely redesigned with longer stator yokes and shorter end shields. Collectors and brushes are located inside the yoke for protection against physical damage, dripping moisture, dust and dirt.

Capsule-type bearings give better bearing protection, too. The upper half of the end shield may be removed for inspection or cleaning of the interior of the motor without disturbing the exciter or exposing the bearing to the ravages of dirt, dust and oil contamination.

**All leads enclosed** — Both primary and secondary winding leads are brought out through separate conduit boxes. There is no loose wiring . . . no exposed leads anywhere.

**Easy maintenance** — Even though the new design offers maximum protection to brushes and collectors, internal parts are fully accessible for inspection and maintenance through large openings in the stator yoke. Opening covers are readily removed and are secured during operation by easy-operating, self-locking fasteners.

**Get details now** — This new design is available from approximately 250 hp at 300 rpm and up, in drip-proof and splash-proof construction. Call your Allis-Chalmers representative for complete details or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 05R8183. A-4464

# ALLIS-CHALMERS

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## . . . LATHE VERSATILITY

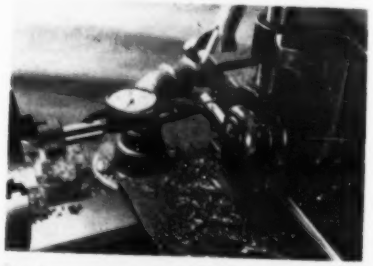


Fig. 4. A magnetically-held dial indicator can be used to square the slide face with cross-travel, position work, or to align the fixed jaw of vise

indicator to be mounted on the chuck body or on the front faces of the jaws, as shown in Fig. 4, where it will adhere firmly. It will also secure the dial gage to the tool post and any other part of the machine where it may be needed. For lathe work, it will be found that the magnetic indicator holder, as illustrated in Fig. 4, is sufficiently flexible for most purposes and eliminates entirely the need for swivelling joints and other means of adjustment commonly used in dial indicator mountings. The indicator can be used for adjusting the vertical slide face so that it is parallel with the lathe cross-slide travel. Also, it can be used in the same position on the lathe chuck for aligning accurately the fixed jaw of the machine vice when this is first mounted in place.

Holding of small diameter rods in the machine vice for keyway milling or cross drilling is assisted if they are seated in a V-block, as illustrated in Fig. 4. Alternatively, a shallow V (see Fig. 1) may be cut across the fixed jaw of the machine vise so that no separate V-block is required.

Facing of work pieces which are too large or awkwardly shaped for swinging on the lathe face plate can be accomplished by utilizing various versions of the method illustrated in Fig. 3. In the example shown, the bottom surface of a machine vise casting is being machined flat.

Another surfacing operation which may be done by means of the vertical slide is illustrated in Fig. 5. In this example, the ends of a long rectangular section bar are being faced off accurately to length by using an end milling cutter mounted in the headstock chuck.

The advantages of the swivelling motion about a vertical axis are also apparent from Fig. 6, in which holes are being drilled through a piece of work with their center lines at an angle of 60 degrees to the work surface. A similar setup on a drilling machine would require considerable clamping and setup time. Using the vertical slide, it is merely necessary to mount the work in the vise and then to swivel the slide about on its vertical axis so that the desired angular setting may be read off the protractor scale. The hole centers, marked out previously, are aligned with the lathe spindle axis by using a conical pointed tool gripped in the lathe chuck. To give the drill a true start, the hole was commenced with an end mill of a suitable diameter and which would not deflect when the work was fed to it by means of the longitudinal saddle feed. The end-milling cutter produced a shallow flat-bottomed hole upon which the twist drill could make a true start without wandering out of position.

Provision of a swivelling movement about a horizontal axis can be utilized for work pieces similar to that illustrated in Fig. 7. The bushing gripped in the vise has a bayonet type slot milled in its exterior; the slot runs parallel to the bush axis for a short distance and then changes direction, finishing at an angle of 30 degrees to the bush axis. The first part of the slot is milled by feeding vertically downward for the desired distance. The second part is milled by swivelling the vertical slide to the required angle and then traversing the work past the cutter by means of the lathe cross slide. The slot is milled completely at one setting of the work in the vise.

In Fig. 8 is shown a large cemented carbide tool held in the vertical slide for turning a piece of hard cast iron. The vertical slide adjustment enables this tool tip to be placed at correct center height for efficient turning. Also in Fig. 8 is illustrated another form of work holder which is often preferable to the machine vise. It comprises a pair of small angle plates, the upper one having clamping screws fitted to it. It has the advantage that work overhanging from the vertical slide table is reduced to a minimum.



fold along this line — outside edges toward you

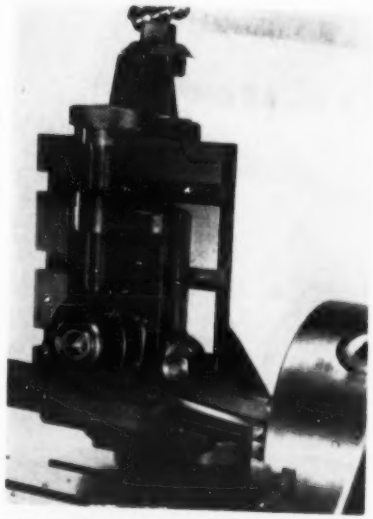


Fig. 5. Slide table is turned 90° for long work

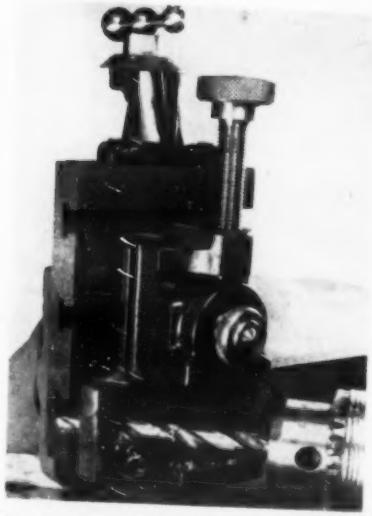


Fig. 6. Table swivelled 60° for angular drilling

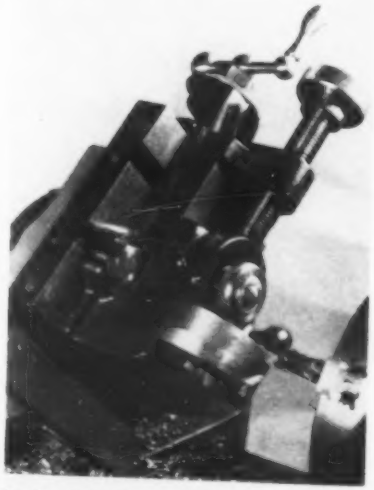


Fig. 7. Universal slide also swivels about horizontal axis to permit a change in angle of cuts

Fig. 8. Vertical slide can serve as holder for stationary tools, therefore it can stay on lathe

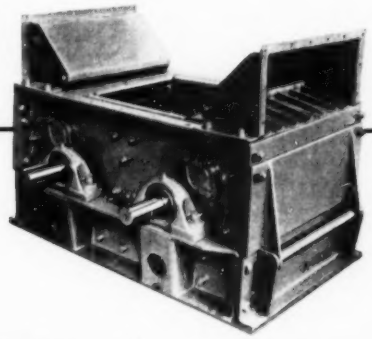
# WET COAL IS NO PROBLEM!

## S-A

DOUBLE ROTOR

## KNITTEL CRUSHER

**Can't Clog... Maintains Rated Capacity on Sticky, Wet Coal**



Snow or rain-soaked coal doesn't reduce the crushing capacity of an S-A *Double Rotor* Knittel Crusher. *Two* high speed rotors, rotating towards each other on separate drives, split oversize lumps—reduce run-of-mine coal to size in a single operation.

In the S-A Double Rotor Knittel Crusher, there are no breaker plates on which material can accumulate and reduce crushing capacity or clog the crusher. *Rated capacity is maintained, regardless of the wetness or stickiness of the coal.*

The double rotors, each with two gangs of triangular sectors, permit access of large lumps, with minimum pulverizing. The reduced lumps are crushed against grates with slots gauged to pass coal of the desired size. The sectors are free to recoil under impact with foreign material, and so protect the crusher from injury. An automatic tramp iron release has steel fingers that lift to pass uncrushable material, without stopping the crusher and with minimum loss of product.

S-A Double Rotor Knittel Crushers are available in capacities to meet your coal sizing and tonnage requirements. Mail the coupon for full information and prices.

SINCE 1901 S-A STEPHENS-ADAMSON MFG. CO.

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| **Engineering Division** | Specialists in the design and manufacture of all types of bulk materials conveying systems. |
| **Standard Products Division** | A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls,—etc. |
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Please send me your Bulletin No. 12-C on S-A Crushers and representative prices.

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# Fire Extinguisher Selection Guide

Recommendations by the Factory Insurance Association

| TYPE OF EXTINGUISHER → | Soda and Acid | Water Type | Loaded Stream | Anti-Freeze | Pump Tank | Water pails (with or without cask or drum) | Vaporizing Liquid†† | Foam | Carbon Dioxide | Dry Chemical |
|---|---|---|---|---|---|---|---|---|---|---|
| SUITABLE FOR — CLASS A FIRES Wood, textiles, paper, rubbish, etc. | YES | YES | YES | YES | YES | YES | No, except very small fires. | YES | No, except very small fires. | No, except very small fires‡ |
| SUITABLE FOR — CLASS B FIRES Gasolene, oils, grease, paint, flammables except alcohol type. Alcohols, acetone, ketones, ethers, and "polar" solvents. | NO | NO | YES | NO | NO | NO | YES | YES | YES | YES |
| SUITABLE FOR — CLASS C FIRES Electrical equipment | NO† | NO† | NO† | NO† | NO† | NO† | YES | NO | YES | YES |
| Method of operating | Invert | Invert and bump on floor. | Invert and bump on floor. | Invert and bump on floor. | Pump | Throw | Pump or open valve. | Invert | Open valve or squeeze trigger. | Open valve and nozzle. |
| Means of expelling extinguishing agent | Chemical reaction to form carbon dioxide. | Carbon dioxide cartridge. | Carbon dioxide cartridge. | Carbon dioxide cartridge or chemical reaction. | Hand Pump | Throw | Hand pump or stored pressure. | Chemical reaction to form carbon dioxide. | Under pressure in extinguisher. | Carbon dioxide cartridge. |
| Effective range | 30–40 feet | 30 to 40 feet | 30–40 feet | 30–40 feet | 30–40 feet | 5–10 feet | 20 to 30 feet | 30–40 feet | 3 to 8 feet | 5–20 feet |
| Approximate duration of discharge at room temperature | 2½ gal.–1 minute<br>1½ gal.–1 minute | 2½ gal.–1 minute | 2½ gal.–1 minute<br>1¾ gal.–¾ minute | 2½ gal.–1 minute | 5 gal.–2 minutes<br>2½ gal.–1 minute | Variable | ¾–1 minute | 5 gal.–1 minute<br>2½ gal.–1 minute<br>1½ gal.–½ minute | ¼–½ minute | ¼–½ minute |
| Principle extinguishing effect | Quenching | Quenching | Quenching or smothering | Quenching | Quenching | Quenching | Smothering | Blanketing | Smothering | Smothering |
| Requires protection from freezing | YES | YES | NO | NO | Yes, unless calcium chloride solution is used. | Yes, unless calcium chloride solution is used. | NO | YES | NO | NO |
| Annual maintenance required | Discharge, refill and tag. | Weigh cartridge, renew water and tag. | Weigh cartridge, restore liquid level and tag. | Weigh cartridge, restore liquid level and tag. | Inspect, partly discharge, refill and tag. | Empty and refill. | Inspect, partly discharge, refill and tag. | Discharge, refill and tag. | Weigh and tag. | Weigh cartridge and tag. |
| Composition of extinguishing material | Water with products of sodium bicarbonate solution and sulphuric acid reaction. | Water | Water with dissolved potassium carbonate and special salts. | Water with dissolved calcium chloride and corrosion inhibitor. | Water with or without calcium chloride. | Water with or without calcium chloride. | Carbon Tetrachloride specially treated with corrosion inhibitor and freezing point depressant. | Foam from reaction of aluminum sulphate and sodium bicarbonate solutions with foam stabilizer. | Carbon dioxide as gas and snow. | Dry chemical. |
| Weight fully charged | 1¼ gal.–20 lbs.<br>1½ gal. to 25 lbs.<br>2½ gal.–30 lbs. | 2½ gal.–35 lbs. | 1¾ gal.–25 lbs.<br>2½ gal.–40 lbs. | 2½ gal.–40 lbs. | 2½ gal.–40 lbs.<br>5 gal.–65 lbs. | 25–30 lbs. | 1 qt.–7 lbs.<br>1 gal.–25–35 lbs.<br>3 gal.–75 lbs. | 1½ gal.–25 lbs.<br>2½ gal.–35 lbs.<br>5 gal.–70 lbs. | 7½ lb.–35 lbs.<br>15 lb.–50–60 lbs.<br>20 lb.–55–75 lbs. | 12 lb.–40 lbs.<br>20 lb.–55 lbs. |

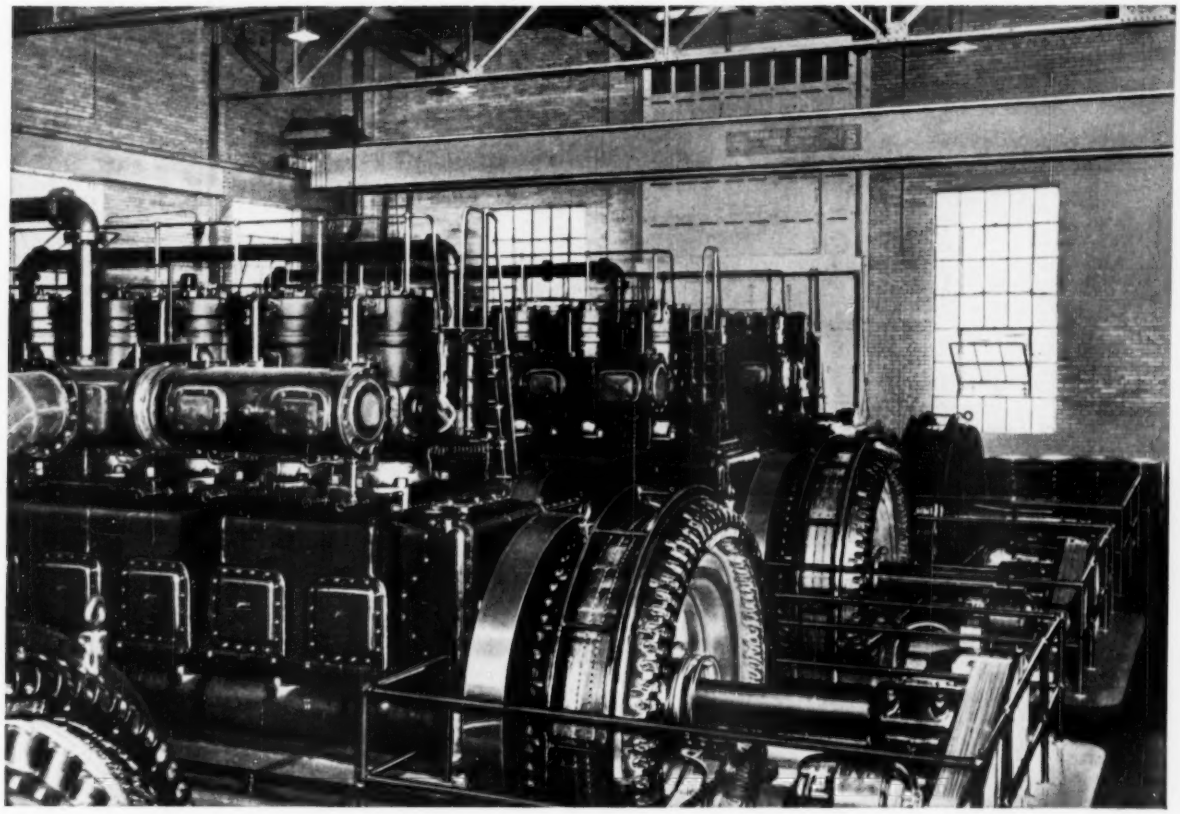
| CALCIUM CHLORIDE SOLUTIONS (Calcium chloride furnished by extinguisher manufacturers contain a corrosion inhibitor) | Freezing Temperature | Water | Calcium Chloride | Specific Gravity | Degrees Baumé |
|---|---|---|---|---|---|
| | 10° F. | 2 gals. 1 qt. | 5 lbs. | 1.139 | 17.7 |
| | Zero F. | 2 gals. 1 pt. | 6¼ lbs. | 1.175 | 21.6 |
| | 10° below zero F. | 2 gals. | 7 lbs. 6 oz. | 1.205 | 24.7 |
| | 20° below zero F. | 2 gals. | 8 lbs. 6 oz. | 1.228 | 26.9 |
| | 30° below zero F. | 2 gals. | 9 lbs. 2 oz. | 1.246 | 28.6 |
| | 40° below zero F. | 2 gals. | 10 lbs. | 1.263 | 30.2 |

† Fires in electrical equipment can be safely attacked with extinguishers of this type *ONLY AFTER* electric current has been cut off.

‡ Effective for initial attack on fires in combustible fibers but should be followed up with fine water spray.

††Extinguishers of this type should not be used in the vicinity of equipment which may be affected by the highly corrosive vapors resulting from their use.

Due to the toxic effect of gases or vapors generated by the use of this liquid, special precautions *Must Be Taken* to avoid breathing these vapors particularly in confined or unventilated spaces.



# "We're Proud of This Plant!"

*says Don H. Decker,* — Plant Supt., Thumb Electric Cooperative, Ubly, Mich.

Manager Orville Hurford and Mr. Decker are justifiably proud of their 4-diesel engine generating station. The plant has been an outstanding financial success since the day it was first opened. Several times it has occupied #1 position on the REA Running Plant capacity chart.

Mr. Decker writes, "A large part of our operating success we attribute to Sinclair GASCON® D oil. It has given us an excellent rate of consumption while reducing wear. In fact, *cylinder and piston ring wear is much below normal based on other plants of equal capacity*. Something else we appreciate is the timely visits of the Sinclair Lubrication Engineers."

Top quality lubricants plus the assistance of Sinclair Lubrication Engineers are two of the reasons why Sinclair can play a large part in the success of *your* operation. Your local Sinclair Representative will be happy to explain the remaining reasons. Phone him or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

## SINCLAIR DIESEL LUBRICANTS

*save Wear and Replacement*

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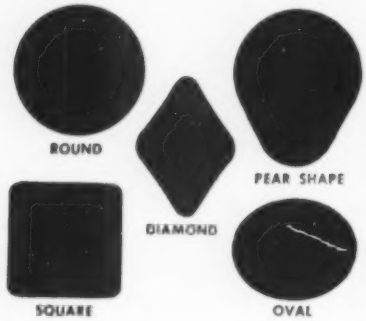
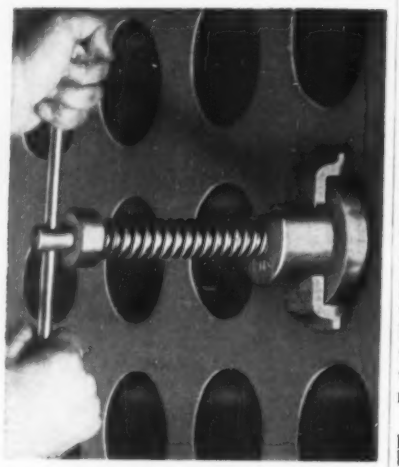
# ROTO *Hand Hole* Seat Scraper

## *Eliminates Dirty, Tedious Work*

**Here is a simple, hand-operated tool for cleaning inside caps on boilers that will pay for itself many times over. This tool is equipped with retractable knives mounted on a revolving spindle having a bearing within a substantial yoke. An adjustable spring automatically maintains tension on the knives, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right, and the job is done. A half turn to the left releases the tool. Try a Roto Seat Scraper and you'll wonder how you ever got along without one.**

**These are some of the hand hole shapes cleaned with a Roto Seat Scraper. Various sizes available.**



*Illustrating ease of operation of Roto Hand-hole Seat Scraper.*

*Roto Hand-hole Seat Scraper for B & W Boiler.*

## What Users Say—

**It did a fine job. Completed the work in 80% less time.**
*(Engineer, Chemical Plant)*

**Roto Seat Scraper has paid for itself many times over on our Keeler Boiler.**
*(Supt., Public Utility)*

**One man cleaned inside cap seats on boiler header in 4 hours. Formerly took 2 men 3 days.**
*(Pennsylvania Manufacturer)*

**We also make a Reseating Machine for cleaning outside caps to assure a smooth, true fit. Send for details.**

***SEND FOR BULLETIN***

**ELLIOTT COMPANY-ROTO DIVISION**
147 Sussex Ave. Newark 1, N. J.

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## Heater Drain Pumps

*continued from page 71*

head, it is quite possible to build up the thrust forces beyond the capacity of even high thrust motor bearings. In these cases, it is necessary either to incorporate a thrust bearing in the pump itself, or to balance this thrust hydraulically through the use of individually balanced impellers or an independent balancing device.

Since these heater drain pump applications can involve temperatures, pressures, and developed heads which a few years ago would have been considered moderately high head boiler-feed pump operating conditions, it is logical to follow the lead of boiler feed pump application in choosing materials of construction. For instance, bronze impellers and trim are not usually indicated for temperatures over about 250 F. Beyond this temperature, the use of chrome alloy steels is usually recommended. At still higher temperatures, it is unwise to use cast iron bowls and carbon steel column pipes and discharge pieces, since the effects of corrosion and erosion are greatly accelerated, and chrome alloy steels are required to produce economic life. This is also true where corrosion-erosion effects have been previously noted. However, since velocities in the can itself are quite low, it is not necessary, at present, to fabricate these cans from anything but carbon steel. Perhaps the day will come when stainless clad cans will be considered a very good investment.

In high temperature vertical can pump applications, provision must be made for thermal expansion. Rather than imbed the can itself in the foundation, it is often found wise to imbed in the foundation an outer shell, such as a section of standard pipe of larger diameter than the can and slightly longer. The can is then hung within this outer pipe and is free to expand both radially and longitudinally.

## What Ruined the Cooler?

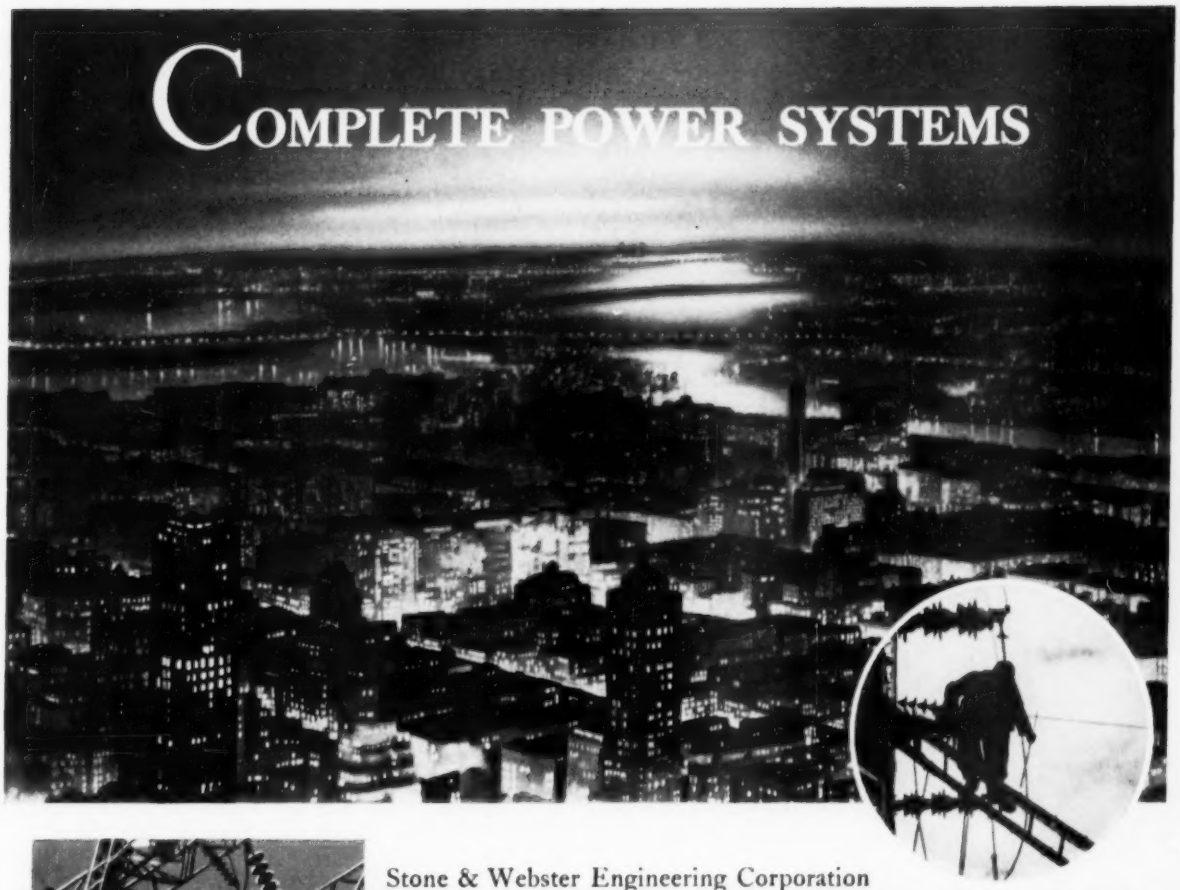
*continued from page 87*

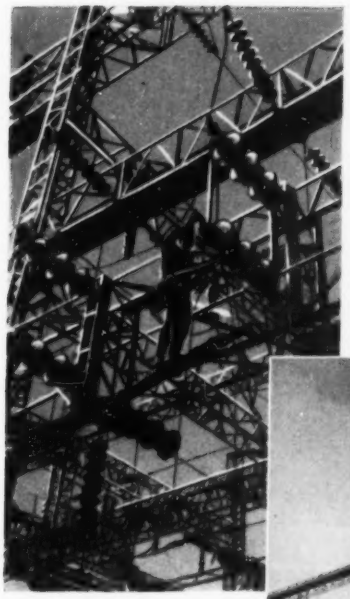
between the header and receiver.

As the receiver was located in a warm place in the engine room and the condensers out-doors, a 1-in. pressure-equalizing pipe was installed between the shell of the receiver and the gas inlet header of the condensers to prevent pressure from building up in the receiver in excess of that in the condensers. This eliminated the tendency for liquid to accumulate in the condensers because it could not flow freely into the receiver.

A foul gas purger was installed to permit maintaining the system free

# COMPLETE POWER SYSTEMS





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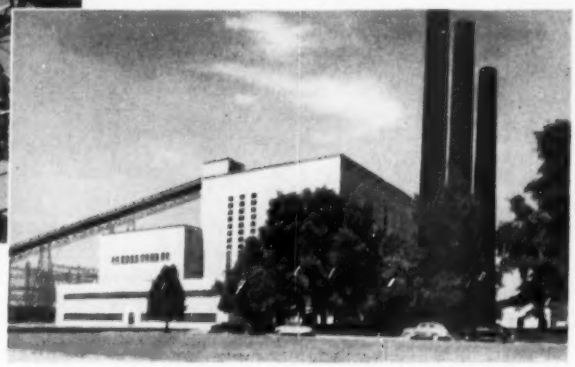

*Write or call us for information as to how our experience may be of assistance to you.*

## STONE & WEBSTER ENGINEERING CORPORATION

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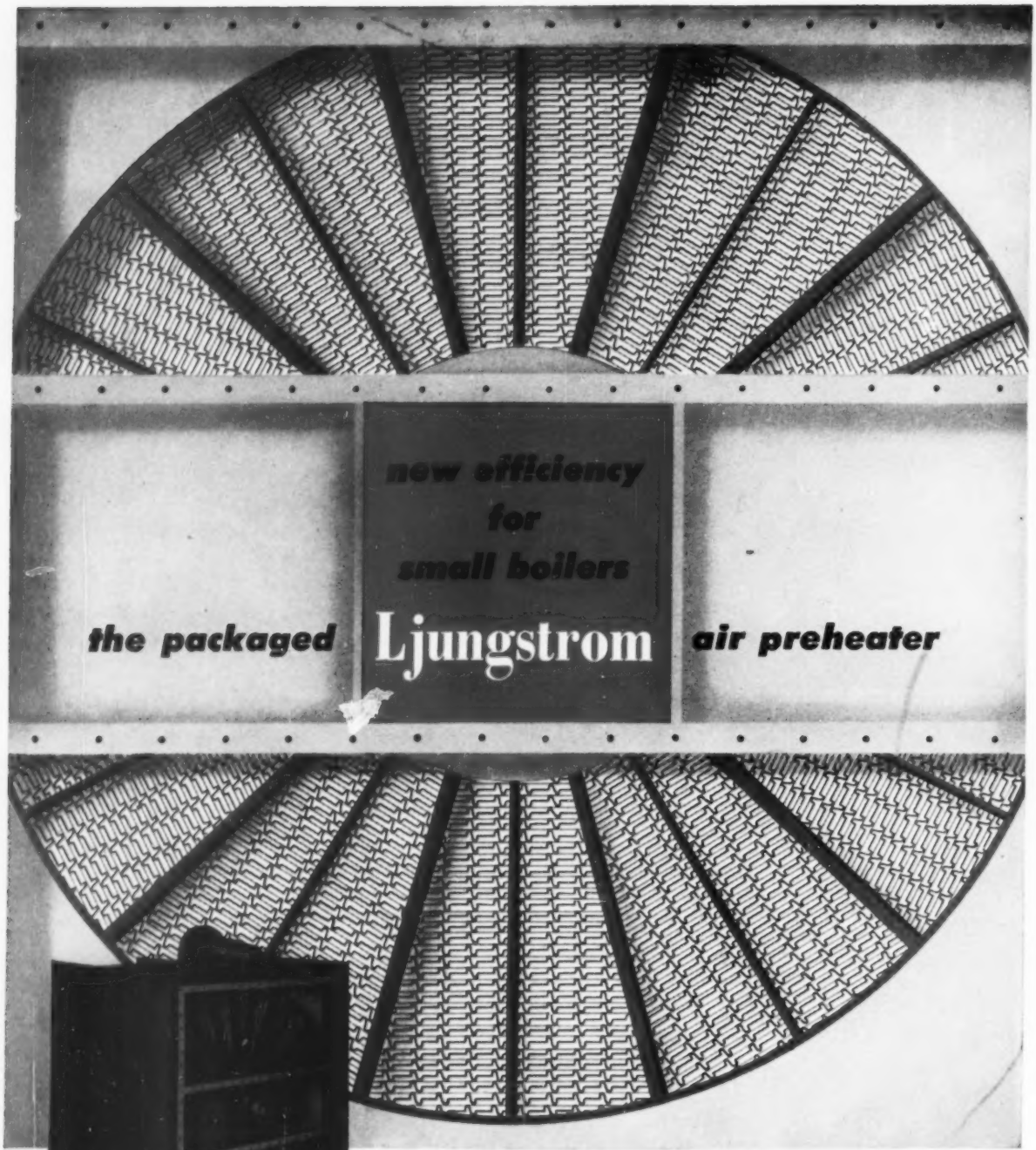


Even boilers as small as 25,000 pounds of steam per hour — can now operate at fuel efficiencies you never dreamed of. With the new *Packaged Ljungstrom*, you can apply the principles of heat recovery universally used in large utilities. The Packaged Ljungstrom Air Preheater operates on the *continuous regenerative counterflow* principle. Waste heat in products of combustion is absorbed on specially designed surfaces in the slowly rotating rotor. As the surfaces enter the stream of incoming combustion air, they transfer their heat to this air. The entire unit is self-contained as you receive it. For more detailed information – get in touch today with The Air Preheater Corporation.

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## What Ruined the Cooler?

*continued from page 106*

of air and other non-condensable gases.

Operating results during the following summer were decidedly improved. Fuel bills decreased, ice output was up and there was no further necessity to haul in ice from other cities to make up for the deficiency in output.

## Coal Storage

*continued from page 92*

Cleaning may have to be done manually to insure complete removal of old coal.

2. Do not mix fresh coal with stored coal in bunkers unless coal is to be used within a few weeks.

3. If coal has tendency to hang up, use vibrators or consider stainless steel linings.

4. Where segregation occurs, try distributors in bin. Also, analyze method of filling bin or silo with a view toward achieving more even loading.

5. In case of silos, conveyors should be so arranged as to allow ready means of moving coal in dead storage to live storage at first indication of heating.

### Check for Heating

Normally, a coal which has a tendency to absorb oxygen will heat at a place inside a pile where oxidation is rapid but cooling by ventilation relatively low. The temperature will either reach a level where the rate of heat release is equal to the rate of heat loss or else it will continue to increase until ignition takes place.

First four to eight weeks in the life of a stockpile are the most critical. The temperature may rise to between 125 and 160 F, depending on the coal, and remain there for some time until it gradually decreases. If, after a period of several months, no temperature rise is observed in any part of the stockpile, the coal may be assumed safe.

On the other hand, the temperature may continue to rise until ignition occurs. At this point the temperature is 450 F or above, and large volumes of carbon dioxide and water vapor are given off. The stockpile is said to be "on fire."

Areas developing heat can be detected by the appearance of the coal under different weather conditions. In wet weather, the hot area is detectable by the rapid drying, and the much lighter color of the coal above the hot spots than in the adjacent coal. Streams of vapor on a cold day or a day of high humidity, and the odor of gas, are indications of heating or air entering the pile. Hot spots


*For* **BOILER BLOW-OFF** *Safety*

Standard Quick-Operating Everlasting Valve

Everlasting Y Valve

Everlasting Angle Valve

These Everlasting Valves are assuring safety in boiler plants all over the country. Each type is stoutly built, with ample strength, resistance to wear, and lasting tightness. Angle and Y designs have interchangeable parts for each size. The three types can be arranged in any combination as Duplex Boiler Blow-Off Units. All Everlasting Boiler Blow-Off Valves conform with ASME Codes, and are available in a range of sizes for pressures up to 600 psig.

*Two of the many available combinations of* **EVERLASTING** *Duplex Boiler Blow-Off Units*

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**Everlasting Valves**

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*for everlasting protection*

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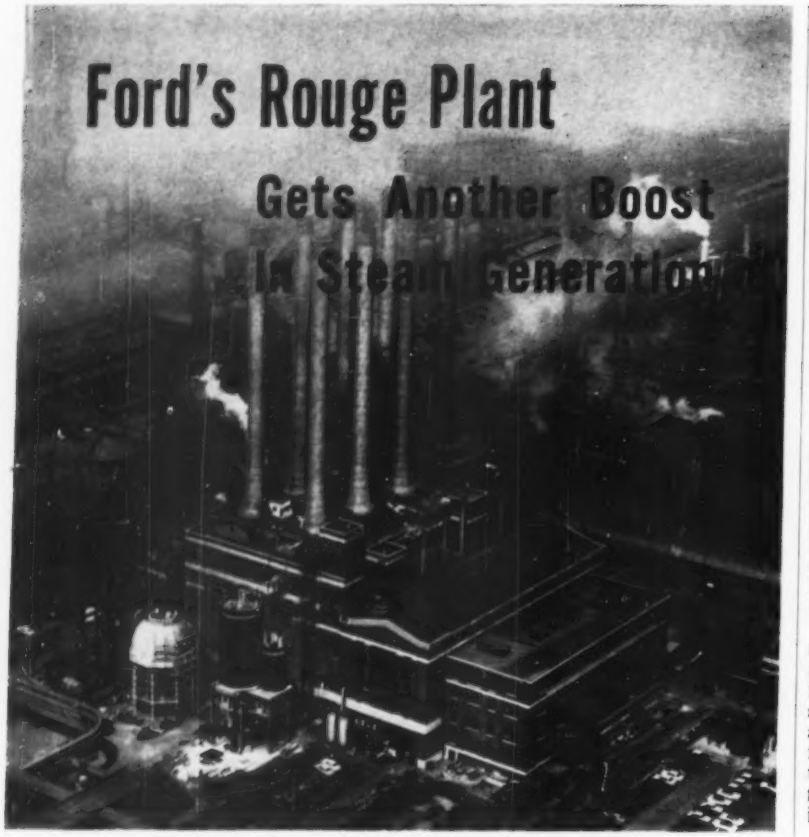


The Rouge Power Plant has kept more continuously abreast of progress in the fields of fuel burning and steam generation than any other plant in the world. In fact, since its construction in 1920, it has always had a greater steam capacity than any other industrial power plant.

**FORD MOTOR COMPANY** has taken another step forward in the modernization of its facilities by installing three of the largest low pressure steam generating units in industry. The new units, capable of producing a total of up to 1,300,000 pounds of steam per hour, are replacing the low pressure units at the Rouge Power House. The new installation makes possible highly efficient utilization of all available blast furnace gas as well as other fuels.

The Kuljian Corporation was awarded contracts by the Ford Motor Company for the design, engineering, procurement, and construction phases of the entire project.

Included in this latest move to modernize, the Rouge Power Plant is also being provided with complete facilities for a new 200,000 gallons per hour hot lime zeolite water treatment system, including a 1,500,000 pounds per hour deaerating heater; complete fly ash and bottom ash handling equipment; and a fly ash collection system . . . all installed *without interruption* of normal plant operation.

Kuljian is proud to play a part in the steady progress of one of the world's largest and best known industrial power plants.

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## Coal Storage

*continued from page 109*

may be located by probing the coal pile with iron rods inserted 10 or 15 ft apart. The rods may then be withdrawn and felt by hand to see whether heating is taking place. These rods may be left in either permanently or else used as probes. In the latter case, the inserted end should be felt immediately after withdrawal.

Excessive and continued heating is an indication that steps have to be taken to prevent the fire from spreading.

### In Case of Fire

Water should not be used to extinguish a fire in a coal pile or bunker because it may actually aid in the spreading of the fire. The best method is to dig out the hot coal and use it up as fast as possible. Otherwise, it should be spread on low ground where it can be smothered with a bulldozer, or allowed to burn out.

When the pile is large and the hot spot is deep within the pile or in an awkward location, a pile may be fireproofed by sealing the top and sides with an airtight coating of asphalt or coal tar. Preventing air from entering the pile will stop further heating and actually put out the fire at locations having temperatures in excess of the danger point.

While spontaneous combustion has been observed with all coals, all sizes and ranks of coal may be stored safely by following the precautions described in this article. By paying attention to the simple rules based on the restriction of air flow, no trouble due to spontaneous combustion need be expected.

REFERENCES

1. The Storage of Coal, by Vaughan Mansfield, *The Fusion Point*, 1945.
2. Storage of Coal, Ohio Coal Association, 1953.
3. Storage of Indiana Coals, Indiana Coal Preparation and Utilization Society.
4. Storage of Low-Rank Coal, by R. A. Allen & V. F. Parry, U. S. Bureau of Mines Report No. 5034, February, 1954.
5. Segregation in the Handling of Coal, by David R. Mitchell, AIME Tech. Pub. No. 846, 1937.

## Boiler Cleaning

*continued from page 95*

B. minimizing maintenance costs
C. minimizing manpower requirements
D. conserving blowing medium

Other prime requisites of an automatic-sequential system are:

(1) Dependability — should be complete and self-contained.

(2) Flexibility of control — program blowing, sequential blowing, selective blowing by local and/or remote push button control.

A complete system should require no attention during operation. It must anticipate, annunciate and cor-

## PRESSURE, TEMPERATURE AND LIQUID LEVEL CONTROLLERS

**Leslie Controllers** consist of a single or double seated diaphragm control valve operated by a Control Pilot. The latter is an air, water or oil actuated device that produces a variable loading pressure to the valve diaphragm in response to a pressure, temperature or level change in the controlled medium. Controllers are used for any one or any combination of the following conditions:

★ When an exactly controlled level, pressure or temperature is required.

★ When power is needed to assure automatic valve opening after prolonged, tight shut-off.

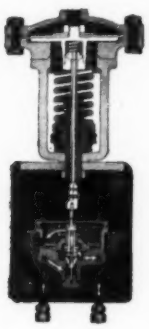
★ When power is needed to operate single-seated valves under high pressure drop.

★ When the available fluid pressure differential doesn't supply enough power for self-operation.

★ When extreme pressure reductions are necessary (i.e. 600 reduced to 10 psi, 900 to 2 psi, 2150 to 5 psi); all can be handled in one step.

★ When fluid contamination requires the simplest type regulating valve for dependable operation.

★ When operation from either a nearby or remote control station is desired.



Control Pilot
Type PD

**LESLIE**
**CONTROL PILOTS**

Simple mechanical device employing constant supply of clean air, gas, water or light oil at 20-22 psi to produce a variable output or loading pressure of 0-20 psi in response to a level, pressure or temperature change applied to operate a control valve or power cylinder controlling fluid flow.

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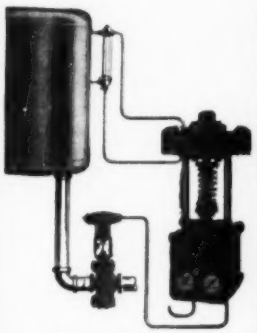

Floatless Level Control
Type UA-1

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Provides accurate control of liquid level (plus or minus 1" water column). Eliminates problems caused by troublesome linkages, torque tubes, floats and stuffing boxes. Simple design provides steady, positive, precise control even under difficult conditions. Consists of Level Control Pilot and diaphragm control valve.

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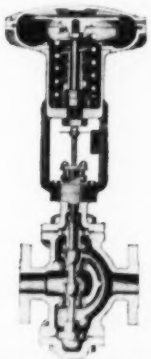

Diaphragm Control Valve
Double Seated Class DV

**LESLIE**
**DIAPHRAGM CONTROL VALVES**
**(Single Seated)**

Control flow of steam, liquid, air or gas. Tight shut-off. Operated automatically by air, water or oil pressure supplied from a Control Pilot or from a loading device such as LESLIE Air Loading panel. Available in unbalanced or fully balanced types, ½-10" in cast bronze, cast iron and cast alloy steels. Primary service ratings to 2500 psi, 1000° F.

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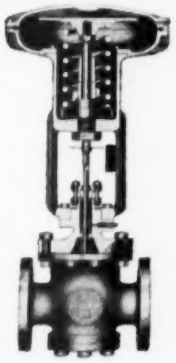

Diaphragm Control Valve
Single Seated Class DL-1

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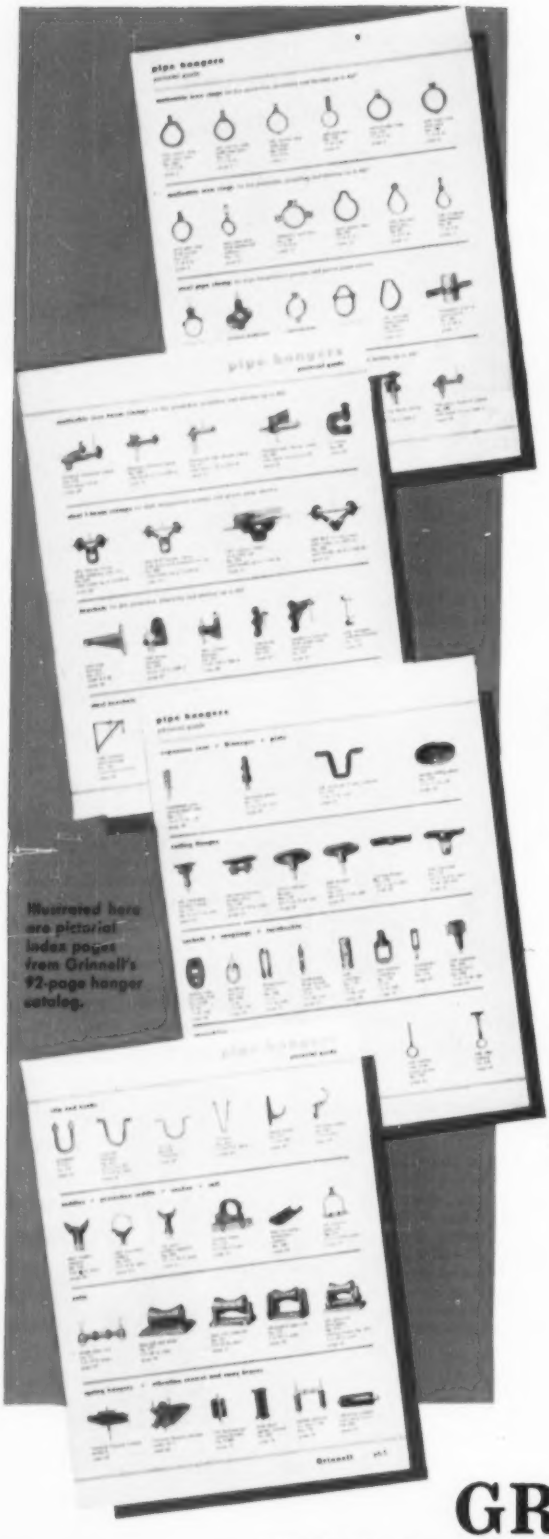


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## Boiler Cleaning

*continued from page 110*

rect malfunctions of the blowers. It must indicate *proper* operation of all blowers by incorporating safety and warning interlocks to provide protection for any contingency in operation of the cleaning system (see Fig. 6). Such contingencies include failure of blowing medium, low or no pressure of blowing medium, mechanical failure of the blowers during operation, excessive blowing medium consumption, mechanical failure of valves, and power supply failure.

Many plant operators also like to have indication of:

(1) The location of blowers with respect to the boiler, especially on large steam generators with 50 to 100 or more blowers. (See boiler diagram in Fig. 6.)

(2) Whether or not a unit is blowing.

(3) Individual flow and/or pressure requirements of blowers, recording and integrating blowing medium consumption. (See flowmeter in Fig. 6.)

In the final analysis, a reliable automatic-sequential system requires minimum manpower, gives complete flexibility of blowing cycle, and maintains control over all blowers at all times. In addition, complete indication and control of the various functions are brought to a central panel. A complete system is frequently less expensive than the so-called sequential or automatic systems.

Analysis of jobs in service has shown that savings made by complete automatic-sequential control has often paid for the boiler cleaning equipment in less than two years.

## Commutator Handstoning

*continued from page 65*

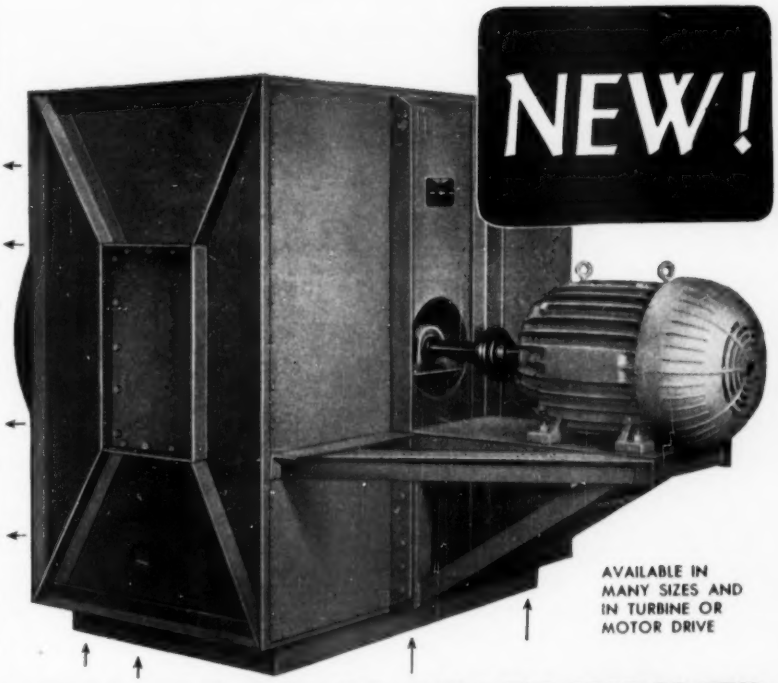
during handstoning, as shown in Fig. 2. Hold stone firmly to prevent any chatter or vibration of the stone.

2 — Just *barely* touch the commutator surface and then wait until stone wears off. Then touch surface lightly again. *Repeat* this procedure until the surface feels smooth to the touch when using a sharp pointed stick. The handstoning cannot be rushed. It takes 20 to 30 minutes per span.

3 — Never *push* the stone into the commutator.

4 — Do *not* try to slide the stone sidewise while in contact with the commutator. Instead, remove the stone from the surface, move it to one side or the other, and again barely touch the commutator surface. After the stone wears off, repeat the process until the desired degree of commutator smoothness is attained.

5 — After handstoning, polish the surface lightly using an Alundum or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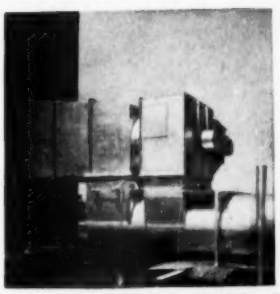

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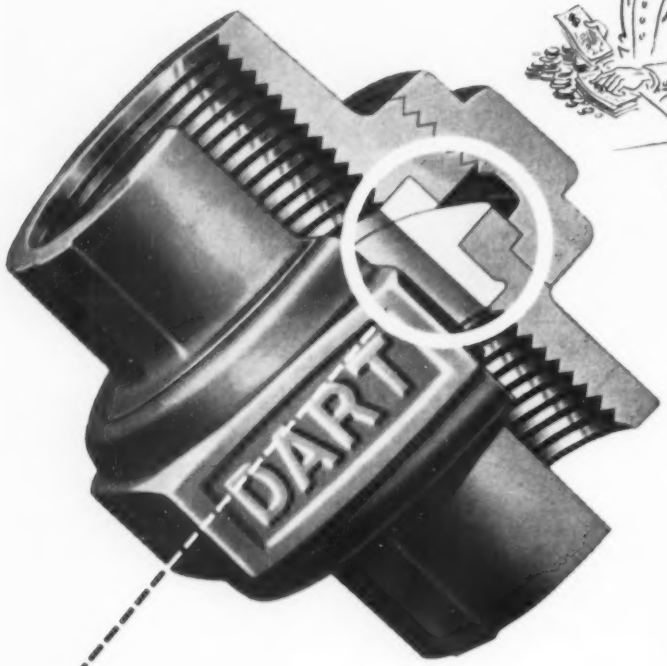


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## Commutator Handstoning

*continued from page 113*

Aloxite cloth or a rubber base stone. The rubber base stone is preferred since it cleans like an eraser, generates very little dust, and does not affect the brush surface.

6 — Blow out the machine using a relatively low pressure. Clean the brushes individually. It is usually unnecessary to bevel the bars immediately, though the commutator should be thoroughly inspected at the first scheduled shutdown, especially for high mica and the degree of beveling.

### On Industrial Machines

Above points apply mainly to the handstoning of high-speed turbine generator exciter commutators. Of course, handstoning can also be used on commutators of general industrial type machines. Again, there are several points that are best followed to get desired results. These are:

1 — Steady the stone on the brushholders or clamp a board to the brush arm to use as a steady rest. Maintain a firm grip on the stone to prevent any chatter or vibration. If possible, lift all brushes. The handstone, if improperly applied, tends to follow the irregularities in the surface and can often exaggerate them.

2 — Press stone firmly against the commutator.

3 — Move stone slowly from side to side in the direction of the commutator bars. Repeat this operation until commutator takes on a clean appearance and feels smooth to the touch when using a smooth pointed stick.

4 — After handstoning, polish the surface using an Aloxite cloth or rubber-base stone. A maple wood block is not recommended for polishing, due to the heat generated by the burnishing action.

## OBITUARIES

### Frank J. Schnaubelt

DEATH CAME last summer to Frank J. Schnaubelt, 75, who for many years prior to his retirement to a quiet life in California, had been one of the top power engineers at Western Electric's vast Hawthorne Works in Chicago.

Born in Austria, Schnaubelt came to this country with his family and settled at Saginaw, Mich.

After a four-year hitch as an oiler and a coal passer in the Navy, he applied for work in 1907 at the brand new Hawthorne Works in Chicago. Schnaubelt was a boiler repairman and an oiler at the Hawthorne power house for only four years before his knowledge of electric power brought him the official rating of "engineer".

It was during this period, from 1910 to 1915, that power to run the giant telephone equipment plant with its 30,000 employees and thousands of machines was being changed from direct to alternating current.

Always a husky and active individual, Frank Schnaubelt tackled

F. J. Schnaubelt

this big project with such enthusiasm that he was soon promoted to chief of the electrical engineering department. Later promotions brought other responsibilities such as mechanical engineering and drafting.

According to present Western Electric engineers who worked with him, Schnaubelt was not only a practical man but a theorist, who spent many lunch hours pouring over problems in calculus, thermodynamics, and other forms of mathematics. Pensioned from Western Electric in 1944 he retained his interest in Hawthorne works to such an extent that, as much as six years later, his wife confided to visitors: "Frank is still working for Western!"

## NEW ENGINEERING BOOKS

**Fresh Water from the Ocean,** by Cecil B. Ellis and members of the staff of Nuclear Development Associates, Inc. Size 6 by 9 in.; 217 pages including index. Published by The Ronald Press Company, 15 East 26th Street, New York 10, N. Y. Price $5.00.

This book is essentially a preliminary engineering survey of the problems and processes involved in the extraction of fresh water from the sea in large quantities. Do not let the word "preliminary" mislead you, however. The survey is sufficiently detailed to support many an argument either for or against desalting, and with the exception of a little fumbling with volumes and areas on page 7 it is believed to be quite accurate.

Basically, the problem is not one of technical feasibility. Water can be desalted in many ways and with equipment now in existence. The problem is one of economy and capacity, but primarily of economy. This is the approach taken by the authors in preparing their report. Each method of desalting is investigated in its technical and economical aspects — including some you may not have heard of before.

The book is well written, comprehensive and thought-provoking.

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## VALVES, TRAPS, PIPING AND ACCESSORIES

**201** **Check Valves** — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

**202** **Valve Chart** — Form 194, 24-pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

**203** **Blow-Off Valves** — Twenty-pp Catalog 12-D1 features a redesigned line of blow-off valves with flanged or welding ends and bolted bonnets for 300, 400–600, 900–1500 lb sp classes, also welded bonnet models with welding ends for 1500 and 2500 lb sp classes. Includes a discussion on "what you should know about blow-off valves," and gives tips on selection, operation, installation of blow-off valves and code requirements. Edward Valves, Inc.

**204** **Lubricated Plug Valves** — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

**205** **To Get at Those Valves** — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

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**206** **Butterfly Valves** — Construction details, engineering and application data on butterfly valves are provided in three illustrated bulletins. Eight-pp Bulletin 557 covers those of standard heavy-duty construction; Bulletin 558, 8 pp, those of standard medium-duty construction; and Bulletin 559, rubber-lined butterfly valves. W. S. Rockwell Co.

**207** **Blow-Off Valves** — Bulletin B-426, 20 pp, on blow-off valves for boiler pressures up to 400 lb wsp, contains installation recommendations, construction information on Yarway seatless and dou-

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**208 For Precise Control** — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manual and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

**209 Steam Valve Calculator** — A slide-chart calculator that quickly estimates pressure drop and indicates proper size steam valve needed for any pressures up to 1500 psi is now available. Printed on calculator are operating instructions. Golden-Anderson Valve Specialty Co.

**210 Pump Valves** — Sixteen-pp Catalog SC-510, now available to power engineers, describes and illustrates valves made to fit practically all makes of reciprocating pumps. Key features of the valves are discussed, and standard, lock-in and deck types are covered in detail. Sims Pump Valve Co., Inc.

**211 Choosing the Right Valve** — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are also discussed and the importance of stem operation is treated. A final chapter is devoted to common materials of valve construction. Crane Co.

**212 Steel Gate Valves** — Five types of Hancock general purpose steel gate valves for process and power piping systems are described in illustrated Bulletin 202 B, 12 pp. Material specifications, dimensions are given, also non-shock service pressure ratings. Manning, Maxwell & Moore, Inc.

**213 Improved Pipe Hanger** — Twelve-pp Bulletin 153 describes company's Counterpoise pipe hanger for high temperature piping systems in steam generating stations, refineries and chemical plants. Tells how it offers efficient load supporting effort of constant value throughout entire range of travel as pipe expands or contracts because of temperature changes. Graphs for selecting proper hangers, tables of dimensions, plus erection are given. National Valve & Mfg. Co.

**214 General Service Valves** — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

**215 Steam Trap Book** — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section ex-

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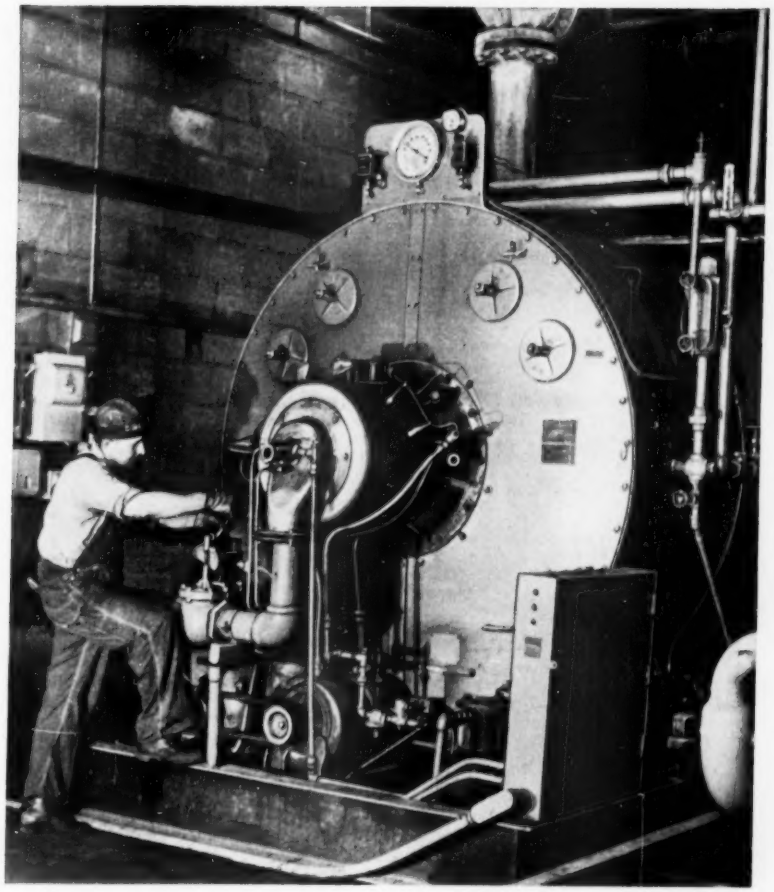

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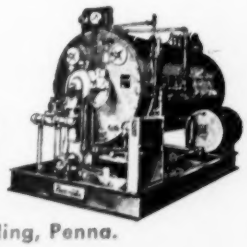

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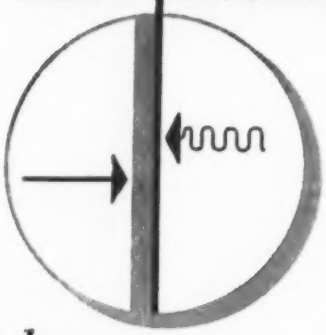

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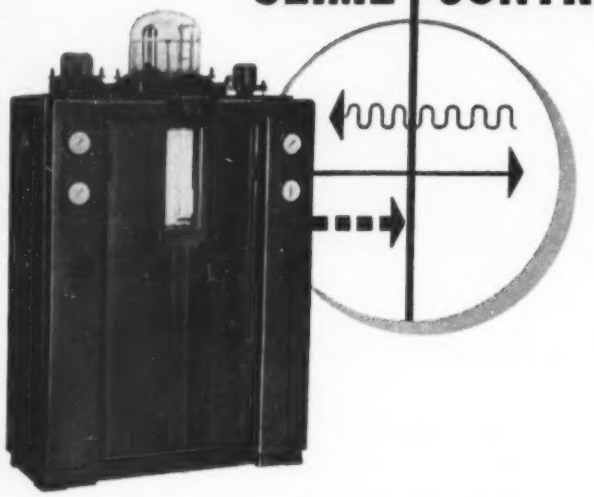

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plaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

**216 Handbook on Fittings, Flanges** — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

**217 Unions and Fittings** — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

## REFRACTORIES

**218 Refractories for Heat, Power** — Compiled to help power engineers solve refractory problems and get greater operating efficiency from their boilers, this booklet provides 32 pp of practical information on company's Crystolon refractories. Properties and characteristics of these silicon carbide products are given and separate chapters cover those for air-cooled, solid wall and water tube protection, and for repairs. Norton Co.

**219 Refractory Concrete** — This 28-pp booklet describes company's Lumnite, a calcium aluminate cement for refractory concrete. Discusses characteristics of Lumnite, methods of making refractory concrete. Chapters are devoted to summary of aggregates and proportions; heat-resistant concrete; refractory insulating concrete; insulating over-coats for industrial furnaces; castable refractories. Universal Atlas Cement Co.

## ELECTRICAL EQUIPMENT

**220 Motor-Generator Reference Book** — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control. Allis-Chalmers Mfg. Co.

**221 Motor Lubrication** — Three methods of lubricating electric motors — cartridge, standard open and company's Lubriflush — are compared in 8-pp Bulletin 1848. To demonstrate action of relubrication in Lubriflush bearings, a series of natural color photos of a transparent bearing housing is reproduced. Necessity of annual lubrication is demonstrated photographically. U. S. Electrical Motors Inc.

**222 Wire, Cable Ordering Guide** — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. Available to qualified power engineers. United States Rubber Co.

**223 Industrial Truck Batteries** — Bulletin IT-520 covers company's complete line of industrial truck batteries and gives details such as dimensions, wet and dry weights, types of containers, and capacities. C&D Batteries, Inc.

## INSTRUMENTS AND CONTROLS

**224 Instruments for Steam Generation** — Bulletin 9050, 32 pp, is a handy reference for all manufacturer's products applicable to steam generation, including electric, pneumatic, electronic and mechanical types of instruments and controls. Power engineers will find it useful in selecting instrumentation for modernization of package boilers. Minneapolis-Honeywell Regulator Co.

**225 Metering and Control Equipment** — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate equipment. Bailey Meter Co.

**226 Instruments, Controls** — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, $CO_2$ meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

**227 Controls for Liquids, Gases** — Bulletin 004, 36 pp, is a revised edition of company's general catalog on measuring and control equipment. This practical book contains information on many types of controllers, gages, manometers, recorders, meters, valves, Venturi tubes etc., applicable for water and sewage works, power and processing industries. Simplex Valve & Meter Co.

**228 Electronic Feedwater Control** — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are given, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

**229 For Feedwater Analysis** — Bulletin 148 BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both $O_2$ and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

**230 Boiler Feed Control** — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feed water automatically according to steam flow. Copes-Vulcan Div., Continental Foundry & Machine Co.

**231 Pneumatic Valve Operator** — This 8-pp bulletin explains operating principles and outstanding features of the Rotomotor positioning operator for throttling control service. Tells how this heavy duty, all-pneumatic operator is designed to combine safety and economy of air operation with the power of a gear driven screw stem. Conoflow Corp.

**232 Transmitter Unit** — Bulletin 9563M describes and illustrates a pneumatic signal transmitter for use with company's ring balance meter. Using a schematic diagram of the operating mechanism, booklet explains how speed, accuracy and stability of the transmitter, in combination with the ring balance meter, provide an instrument adaptable to a wide variety of metering, control uses. Hagan Corp.

**233 Water Level Indicators** — Bulletin WG 1824, 20 pp, revised, describes three models of remote liquid level indicators for boilers, heaters, storage tanks and other vessels in power and industrial process plants, for boiler pressures up to 700, 1500 and 2500 psi respectively. Illustrates a new wide vision dial, an indicator installation, and electronic secondary indicators. Explains how indicator is used, gives typical applications, wiring diagrams. Yarnall-Waring Co.

**234 Ideas on Push-Pull Controls** — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls, micro controls and hand-operated controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

## BOILERS, GENERATORS

**235 Shop-Assembled Boiler** — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000


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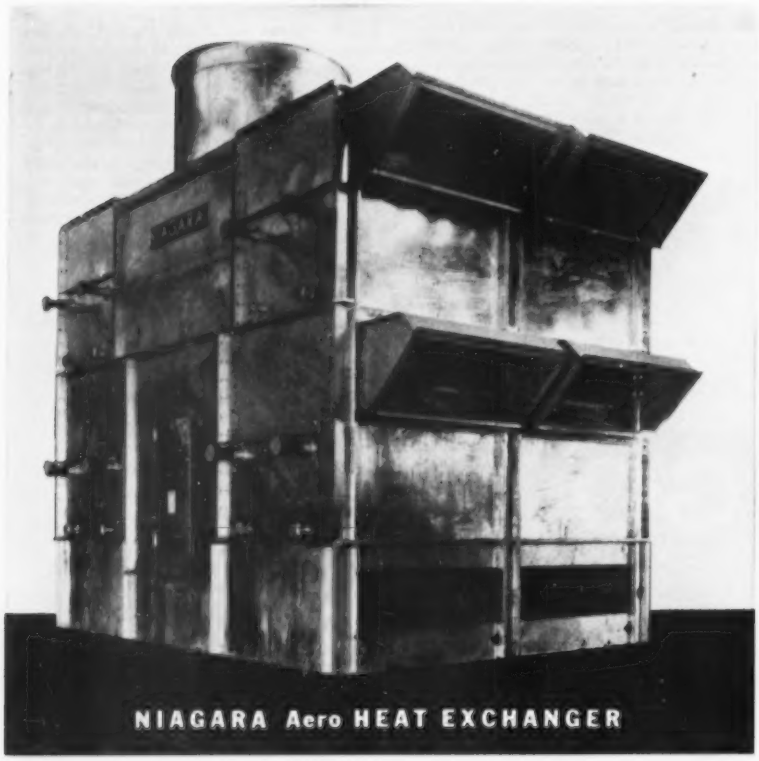

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lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions of the boilers are given. The Babcock & Wilcox Co.

**236 Packaged Boilers** — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

**237 Improved Steam Generator** — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

**238 Preheating Combustion Air** — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Industrial applications for other than power boilers are also covered. Air Preheater Corp.

### BURNERS

**239 Automatic Burner** — Bulletin 420 contains approximately 30 pp of engineering data on a new burner unit for gas, oil or combination firing and sized for capacities to 42,000 lb of steam per hour. Separate sections of this looseleaf manual are devoted to photos and discussion of special features of the burner, general specifications, parts list, wiring and piping diagrams, explanation of operating sequence, and performance data. Available to qualified power engineers, please state your job title when requesting this bulletin. Peabody Engineering Corp.

**240 Oil and Gas Burners** — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. Specifications included. The Engineer Co.

### COAL, ASH HANDLING

**241 Economic Coal Storage** — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

**242 Spreader Stoker Selection** — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader

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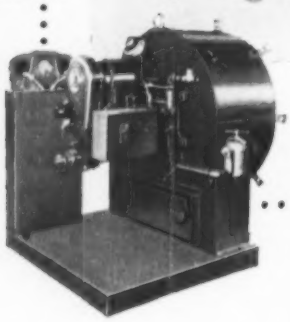

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stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

**243 Automatic Coal Scale** — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

**244 Fly Ash Collection** — The successful and economical separation of fly ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical characteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Western Precipitation Corp.

**245 Spreader Stoker Data** — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

### TUBING AND ACCESSORIES

**246 Condenser Tubes** — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Gives details on proper installation. Scovill Mfg. Co.

**247 Rotary Tube Cleaners** — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

**248 Data on Stress Values** — Data Card 154 is designed to help power engineers concerned with the operation of tubular equipment at elevated temperatures and pressures. The card is an adaptation of Table P-7 of the new ASME Boiler Code and is complete with notes and formulas for calculating maximum allowable working pressures. Tubular Products Division, The Babcock & Wilcox Co.

### FUEL OILS, LUBRICANTS

**249 Diesels, Their Fuels and Lubricants** — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. A chart shows relation of engine performance to fuel properties. Sinclair Refining Co.

**250 Turbine Lubrication** — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations. DeLaval Separator Co.

**251 Versatile Industrial Oil** — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and avail-

able in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

## WATER CONDITIONING

**252 Handbook on Demineralizing** — Bulletin 5800, 39 pp, on treating water by demineralizing, explains principle of ion exchange. Discusses applications of many anion and cation exchange materials; series of curves help estimate cost of operation. Describes design and operation of demineralizer systems, multi-stage systems and mixed bed units. Includes curves of water quality obtainable. Cochrane Corp.

**253 Modern pH and Chlorine Control** — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

**254 What's What on Ion Exchangers** — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, Super Nalcolite. National Aluminate Corp.

**255 Water Conditioning Data Book** — A recently revised reference volume, Data Book 2478A contains 108 pp and presents a compilation of 78 chapters and tables. Subjects covered include hydraulics; impurities in water; chemical conversions; coagulant, acid and alkali dosages; chemicals used in water treatment; water treatment processes; boiler feed make-up requirements; alkalinity relationships; specific gravities; chemical reactions. Available to qualified power engineers, please state your job title when requesting this. The Permutit Co.

**256 Water Treatment** — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

**257 Corrosion Treatment** — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

**258 Microbiological Control** — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary as-

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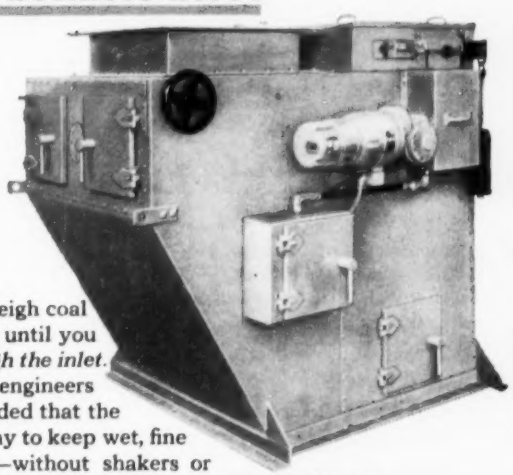

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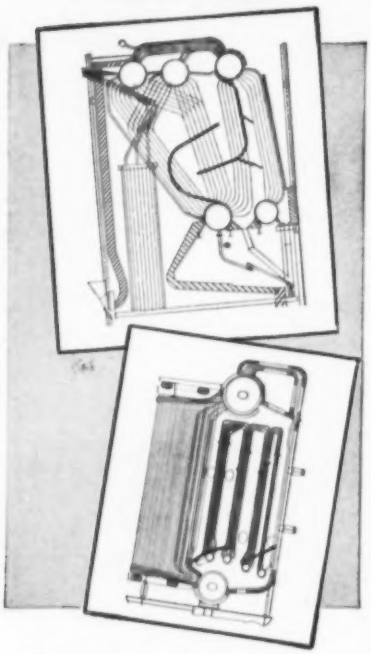

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pects of industrial water treatment. Wallace & Tiernan Co., Inc.

### OTHER EQUIPMENT

**259 Refrigerator Condensers** — Bulletin RC-2, 38 pp, utilizes drawings, tables and engineering data to show how to select proper type from company's line of ammonia and Freon condensers for refrigeration services. Illustrates horizontal multipass shell and tube types; vertical singlepass shell and tube types. Gives pipe sizes for ammonia and Freon lines; stands for large and small condensers. Henry Vogt Machine Co.

**260 Turbine Speed Control** — Thirty-pp wire-bound Bulletin H-21 is titled, "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify the operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

**261 Dry Ice Converters** — This illustrated bulletin describes pressure vessels with removable closures into which dry ice is charged and in which the resulting carbon dioxide is stored indefinitely under pressure. Gives advantages of $CO_2$ for purging or use as an inert gas, and advantages of the dry ice converters as a source of $CO_2$. Dry Ice Converter Co.

**262 Industrial Equipment** — Bulletin WP-1099-B61, 16 pp, describes manufacturer's industrial equipment including centrifugal refrigeration, condensers and coolers, steam power plant equipment, water conditioning deaerators and rotary pumps. Worthington Corp.

**263 Corrosion, Abrasion Control** — Modern practices and products for the positive protection of metal equipment from the effects of corrosion and abrasion are described in this 16-pp bulletin. Covers factory and field application of rubber or synthetic linings to metal parts or products, and maintenance coatings available for application by plant personnel. Also gives detailed information on accelerators, thinners, primers. Goodall Rubber Co.

**264 Motorized Chimney Draft** — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. L. J. Wing Mfg. Co.

**265 Burning Bituminous Coal** — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

**266 Fluid Drive** — Of value to power engineers interested in obtaining adjustable speed operation in a range from 100 to 2500 hp is 24-pp Bulletin 9319, illustrated in color. Covers company's Type VS, Class 4 Gyrol fluid drive, explaining its principle of operation and illustrating its use. American Blower Corp.

**267 For Climate Control** — Bulletin 122, 8 pp, introduces an air condi-


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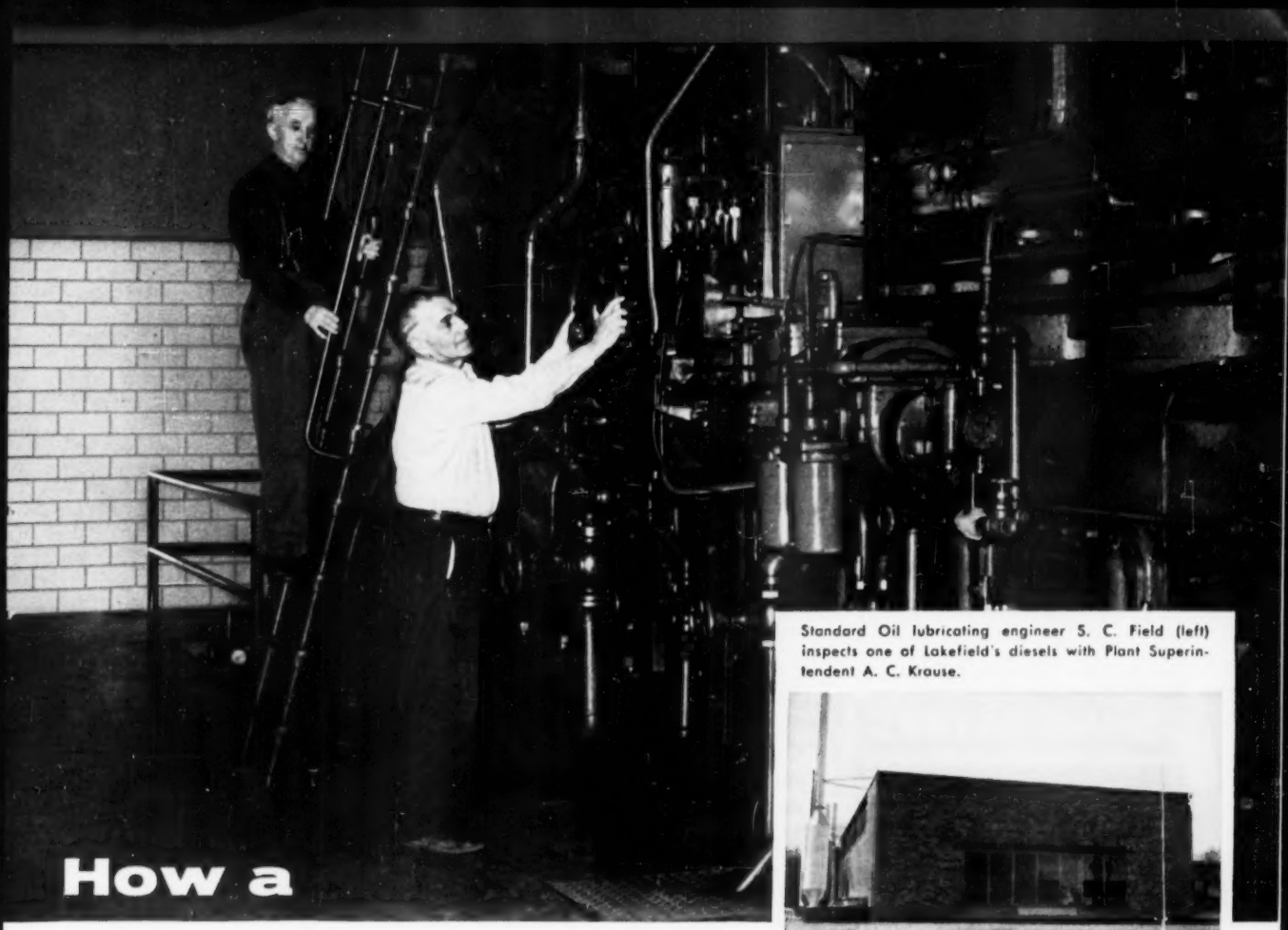

Standard Oil lubricating engineer S. C. Field (left) inspects one of Lakefield's diesels with Plant Superintendent A. C. Krause.

# How a "sightseeing" tour solved our lubrication problem!

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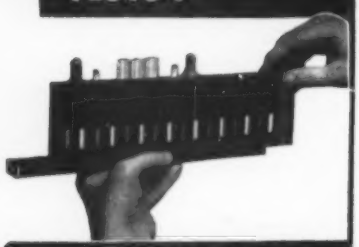

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tioner designed for precise and economical control of air temperature and moisture. Illustrates design of the new machine, tells its features, and pictures some installations. Tells how it may be used in heating and cooling processes, and how it permits processing of moisture-sensitive materials. Niagara Blower Co.

**268 Seals for Bearings** — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

**269 Water Heaters** — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, removable tube bundles. Davis Engineering Corp.

**270 Boiler Feed Pump** — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

**271 Quick-Opening Doors** — Bulletin 2435, 8 pp, outlines advantages of newly developed quick opening doors for pressure vessels. Explains how these doors can be opened and closed in seconds, and are adaptable to both vertical and horizontal units. Process Equipment Dept., Blaw-Knox Co.

**272 Industrial Products Guide** — Newest edition of this company's industrial products catalog is a 40-pp book offering essential data on insulations, refractory products, asbestos cement pipe, packings, gaskets, electrical products, frictional materials, and others. Photos, diagrams, and text have been brought up to date. Johns-Manville.

**273 Power Plant Equipment** — This comprehensive folder illustrates some of the equipment and services provided by this company. Shows heat exchangers, filters, condensers; also such services as re-tubing and metal spraying. Condenser Service & Engineering Co., Inc.

**274 Belt Conveyor Carriers** — Carriers designed for rugged jobs, exposure to dust and long service are the subject of illustrated Bulletin 453. Shows how their spun end rolls and welded steel frame contribute to extra strength and better balance. Stephens-Adamson Mfg. Co.

**275 Sheet and Plate Fabrication** — Illustrated in 40-pp Bulletin F-3 are products of this manufacturer, and equipment used to produce special sheet steel and alloy parts. Shows control panels, switch gear housings, cubicles and other electrical enclosures, boiler air ducts, smoke breechings, tanks. The Kirk & Blum Mfg. Co.

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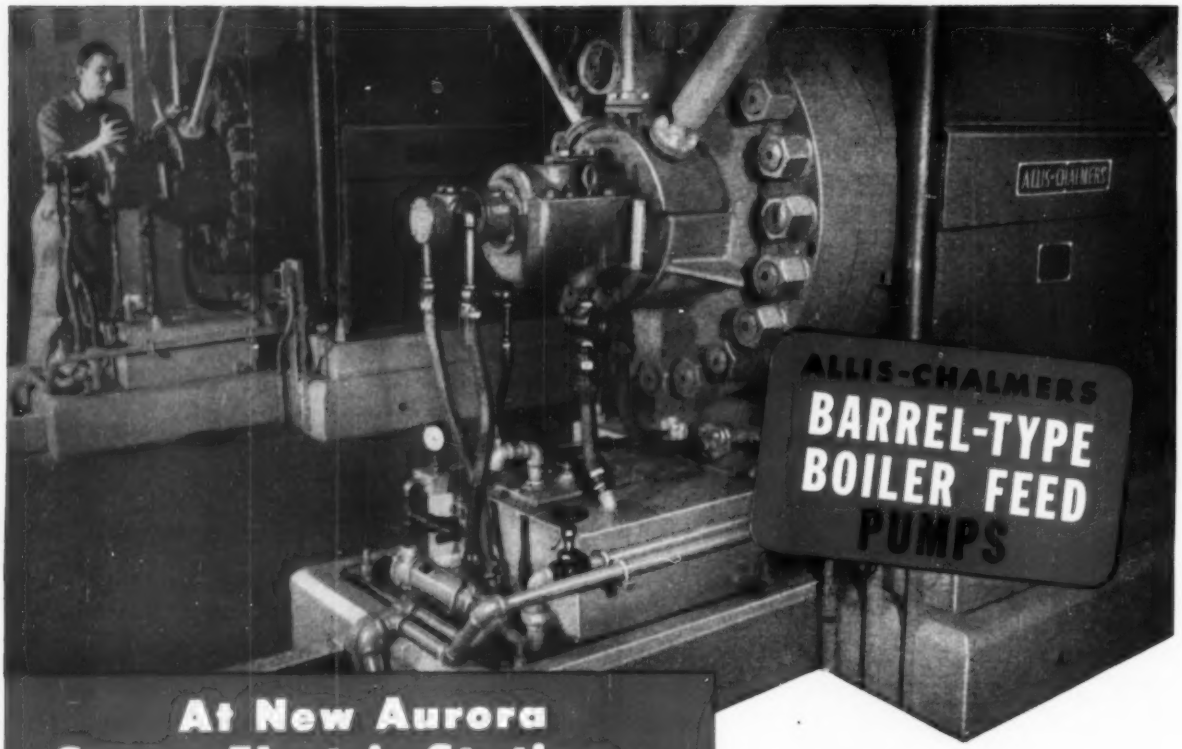


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*continued from page 32*

**158 On Cathodic Protection** — The "whys" and "hows" of cathodic protection are covered in 12-pp Catalog Section S-6500, a complete reference work on the mitigation of corrosion of underground and submerged metal structures by an impressed current cathodic protection system using graphite anodes. Contains information on the cost of corrosion; where and when protection should be applied. National Carbon Co., Div. Union Carbide and Carbon Corp.

**159 Hydraulic Sluice** — Design features and performance advantages of manufacturer's Intelli-Giant are described in this bulletin. Photos show this improved nozzle at work in dam construction and other uses. Chiksan Co.

**160 Water Jet Eductors** — Bulletin 2-M, 36-pp, discusses standard and special SK Water Jet eductors, used in lifting, pumping, mixing and agitating of liquids, in handling of solids and slurries, and in such operations as draining flooded cellars, pumping and mixing in oil treating systems, pumping water out of coal and sand barges. Included is comprehensive information on design, construction, application and operation, methods of pumping and moving liquids and handling solids. Schutte and Koerting Co.

**161 Supercharged Cooling** — A progress report on three years' experience in supercharged internal conductor cooling of steam turbine generators, 8-pp Booklet 05R8168 points out that while supercharged cooling is best suited to 3600-rpm units because of the favorable blower speed, supercharging may ultimately be adapted for 1800-rpm generators as well, possibly with separately driven blowers. Allis-Chalmers Mfg. Co.

**162 To Curb Moisture Damage** — Data sheets are available on dehydrators and humidity indicators for moisture control. They cover Humi-Caps for controlling humidity within instruments, electronic equipment; dehydrator plugs for moisture-corrosion protection of reciprocating engines and other equipment in transit and storage; and Humi-Spots, for indicating excessive relative humidity. DriAire, Inc.

**163 Mastic Coating Guide** — An illustrated discussion of various types of asphaltic mastic protective coatings for use on masonry, brick and concrete side-walls, roofs, storage tanks and process equipment is presented in this Bulletin. Chart listing types of mastic coatings designed to meet different industrial specifications and conditions of service is included, also recommendations for mastics to be used on interior and exterior structural surfaces. Emjay Maintenance Engineers.

**164 Air Conditioners** — Bulletin DS-362, 24 pp, presents information on improved self-contained air conditioning units with capacities from 3 to 20 tons. Describes units of 3-, 5-, and $7\frac{1}{2}$-ton capacity now available with hermetic compressor, also larger units available with water or evaporative type condensers. Line diagrams, wiring diagrams, capacity tables are provided. The Trane Co.


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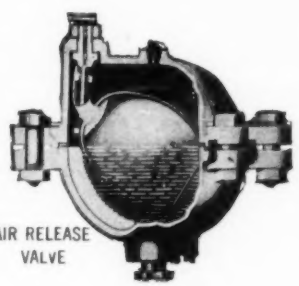


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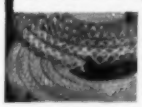

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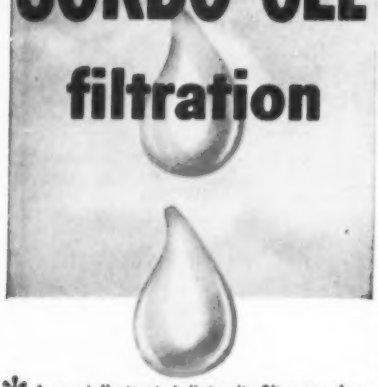

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Cambridge Gas Analyzers provide continuous records, accurate and automatic. No intermittent sampling . . . no moving parts . . . no fragile glassware. These Analyzers are used for determination of

OXYGEN in flue and stack gases and in furnace atmospheres.

CARBON DIOXIDE in flue gases.

DISSOLVED OXYGEN in boiler feed water.

HYDROGEN in steam.

CARBON MONOXIDE, NITROGEN, ARGON and many other gases can be determined by available single- and multi-point Cambridge analyzers designed to meet specific requirements.

Cambridge five-point gas analyzer provides simultaneous analysis and continuous graphic record of the amount of $O_2 CO_2 CO$, $H_2$ and $CH_4$ in a sample of combustion products.

**CAMBRIDGE INSTRUMENT CO., INC.**

**3767 Grand Central Terminal New York 17, N. Y.**

***Pioneer Manufacturers of***

**PRECISION INSTRUMENTS**

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# ELLISON

## PORTABLE LABORATORY TYPE INCLINED TUBE DRAFT GAGE

Ellison introduced the inclined tube draft gage in 1896. The portable laboratory type gage, shown above, combines all of the best features of our inclined tube gages. Monel frame. .2" oil depth. Level and tube replaceable in the field. Screw adjustment for zero setting. Clean out plug and needle valve drain.

Another dependable, highly accurate laboratory gage is the Ellison Inclined-Vertical Draft Gage, used for minus, plus or differential air pressures. A battery of four of these gages is shown at top left, in a testing laboratory set-up at Texas Western College, El Paso.

● ***Ask for Bulletin 109A — tells the whole story of Laboratory Draft Gages.***

**ELLISON DRAFT GAGE CO., INC.**

**550 WEST MONROE ST. SINCE 1896 CHICAGO 6, ILL.**

**The Ellison Line Also Includes:**

Draft Gages, Bell and Diafram—Inclined Draft Gages—Portable Inclined Vertical Tube Gages—Vertical Tube Gages—Oil, Heavy Liquid and Mercury—Single and Multi-Tube-Saturator Gages— U Gages—Stationary and Portable—Air Filter Gages—Dial and Inclined Tube Types — Pitot Tubes — U Path Steam Calorimeters — Portable Gas Analyzers-Orsat Type

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# ....NEED HELP??

## MAINTENANCE SPECIALISTS FOR HEAT TRANSFER EQUIPMENT

CONDENSER SERVICE AND ENGINEERING CO., INC., not only manufactures new equipment; it specializes in repair, adjustment, and replacement of existing equipment of all makes. It maintains extensive facilities for handling emergency repairs. These facilities are available at all times, Sundays and holidays included. Out time reduction can be counted upon when you call CONSECO highly trained specialists, equipped as they are with specially designed tools and equipment for such work. This help is available at a moment's notice.

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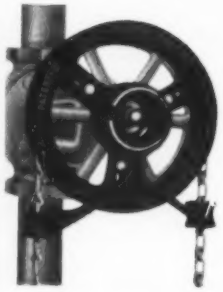
## Protect Your Manpower with...

**Babbitt** *Adjustable* SPROCKET RIM *with Chain Guide*

Control out-of-reach overhead valves right from the floor! No more climbing on ladders, balancing on boilers, perching on workbenches or machines. Prevent accidents and costly claims — also save fuel, steam and money.

Only four simple, quickly-assembled parts installed and operating in only a few minutes, Babbitt Adjustable Sprocket Rim with Chain Guide —



- **Fits all valve wheels**
- **Simplifies pipe layouts**
- **Eliminates risky climbing**

Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems.

*Call your Industrial Distributor. He carries complete stocks.*

**Babbitt STEAM SPECIALTY CO.**

4 BABBITT SQUARE, NEW BEDFORD MASSACHUSETTS

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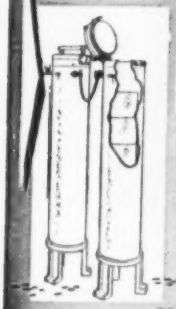
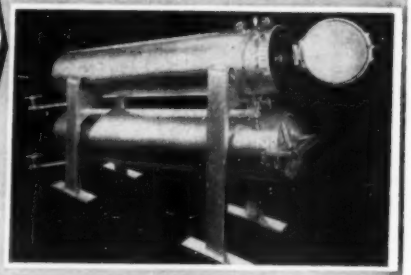
## for PURGING...

### DRY ICE CONVERTERS





**NO OPERATING COSTS!**

Dry Ice Converters are A.S.M.E. code pressure vessels especially adapted for charging full-sized 50-lb. cakes of solid $CO_2$. They may be located any place in a plant and connected by pressure piping to the gas use area. A variety of sizes are available for either vertical or horizontal installation. No electricity, fuel or refrigeration needed.

*Write for folder and prices*

DRY ICE CONVERTER CORP. TULSA OKLAHOMA

**DRY ICE CONVERTER CORPORATION**

Dept. C., Box 1652, Tulsa, Okla.

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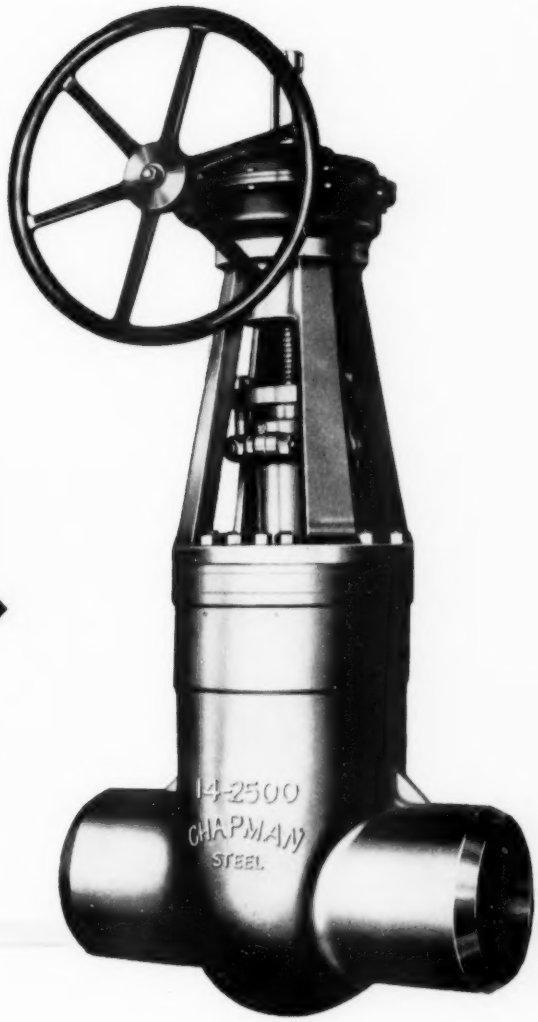
# Two Reasons why
# CHAPMAN
## STEEL VALVES
## Keep Maintenance Low in High Pressure Service




*Carefully-formulated alloys* and *accurately-detailed contours* give Chapman Steel Valves unexcelled dependability under the most severe high pressure and high temperature conditions.

Fourteen alloys are made in Chapman's own foundry, under rigid laboratory supervision, to ensure that every valve is made of the right steel for its specific service.

Precision manufacture to close tolerances is *standard* in Chapman Steel Valves. Designs have been refined to meet the demands of years of smooth operation at minimum maintenance costs. Quality is unsurpassed.

For gates, globes and checks in all pressure classes — 150, 300, 400, 600, 900, 1500 and 2500 psi — and for temperatures to 1150°F, see Chapman first. Valves are supplied with welded, pressure seal or bolted bonnet joints and with flanged or welding ends. Valves equal or exceed ASA standards in every range.

Write for Catalog 20.

**THE CHAPMAN VALVE MANUFACTURING COMPANY**
**INDIAN ORCHARD, MASSACHUSETTS**

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# Permutit Demineralizers deliver highest purity make-up for Illinois Power Company's new 1450 psi steam generator

*Hennepin Power Station, Illinois Power Company. Steam Capacity 525,000 lb/hr. Consulting Engineers: Sargent & Lundy*

This plant's 75,000 KW turbo-generator must operate continuously at high efficiency.

Tips of turbine blades turn at speed faster than sound. At these speeds, slight amounts of *silica* in make-up water quickly build *dangerous* deposits—destroy turbine efficiency, cause costly shutdowns.

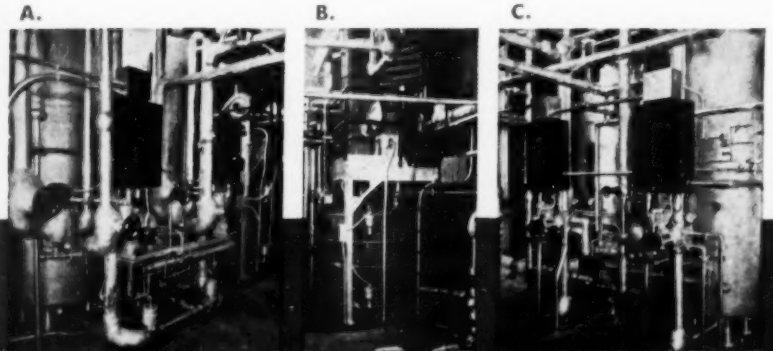
To prevent these troubles, all make-up water is demineralized by the Permutit equipment shown below. Silica is reduced from a harmful 14 ppm to as low as 0.02 ppm—*at low cost!* Total dissolved solids are reduced from 298 to 1.0 ppm!

This keeps 76 miles of boiler tubing free of scale with little or no blowdown. It permits the *high* heat-transfer rates demanded with 1010° F steam at 1450 psi.

Write to us for aid in solving your water problem. Permutit makes the world's most complete line of ion exchangers and water conditioning equipment. We can help save you time and money with the one combination that best suits your needs.

The Permutit Company, Dept. PE-11, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

A. B. C.



A. *Automatic Permutit Q units remove metallic cations from well water supply.*

B. *Permutit Degasifier removes $CO_2$, reducing operating cost.*

C. *Automatic Permutit S units remove remaining troublesome mineral impurities by anion exchange.*

Ion Exchange and Water Conditioning Headquarters for Over 40 Years.

**PERMUTIT®**